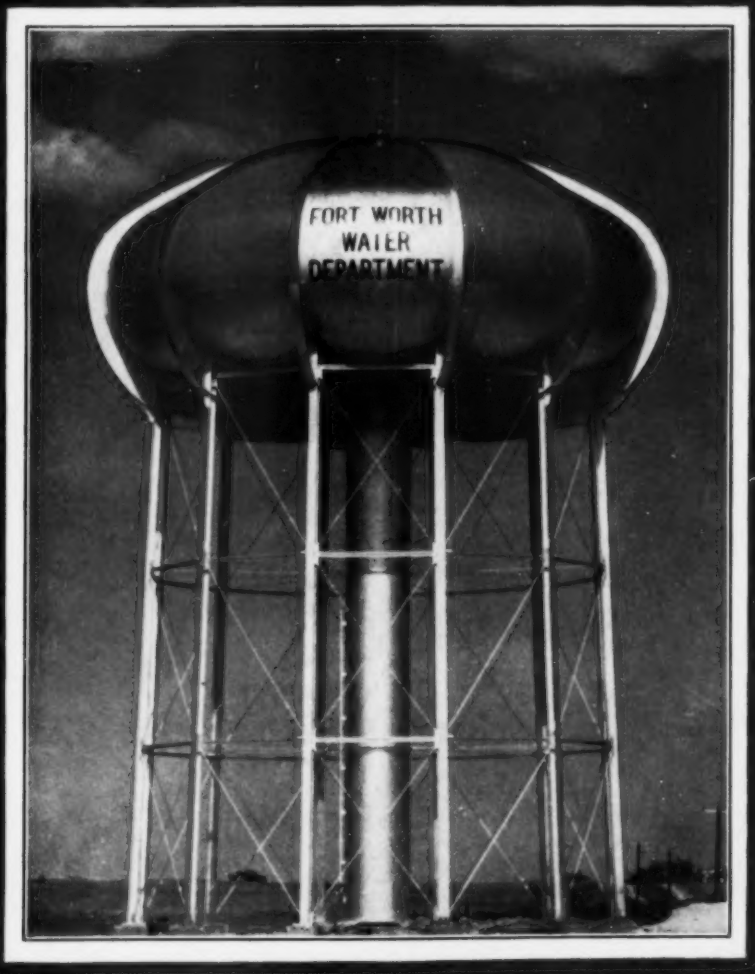
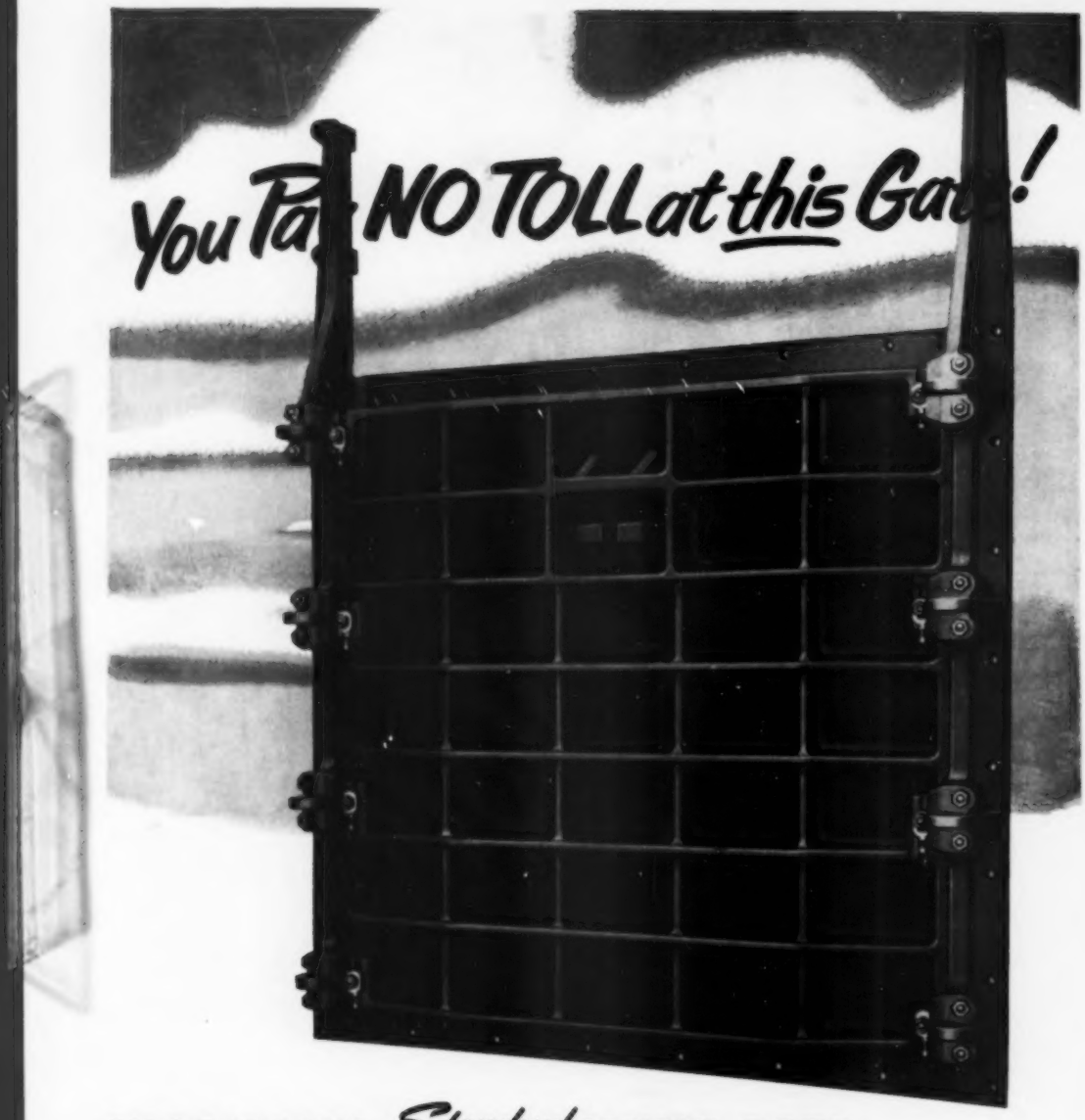
WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



SEPTEMBER, 1952

One of Fort Worth's Newest . . .



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NO TOLL under usual operating conditions . . . because Chapman Sluice Gates have been standardized to meet *all* these conditions. And even for *special* conditions, many designs and patterns are available *at no extra cost.*

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And there's NO TOLL to speak of, in service, for Chapman Sluice Gates are built to last. Send for Bulletin No. 25 — *a real passbook to substantial savings.*

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NEW ORLEANS, LA.

East Jefferson Water Plant

(COMPLETED IN 1951)

S. V. APPLEWHITE
Consulting Engineer
NEW ORLEANS, LA.

JOHN HODGSON, *Pres. & Gen'l Mgr.*
EAST JEFFERSON WATER PLANT
NEW ORLEANS, LA.

Omega Water Works Equipment furnished for the East Jefferson Water Plant:

- 2 — Model GLW-1 Loss-In-Weight Gravimetric Feeders with Extension Hoppers and Dissolving Chambers for feeding hydrated lime.
- 1 — Model GLW-1 Loss-In-Weight Gravimetric Feeder with Extension Hopper and Dissolving Chamber for feeding ferrous sulphate.
- 1 — Model GLW-1 Loss-In-Weight Gravimetric Feeder with Extension Hopper and Dissolving Chamber for standby service.

All feeders equipped for automatic proportional control.

In the construction of this plant it was realized from the outset that it would be no easy task to produce a clear, potable effluent using the Mississippi River as the source of raw water. Consequently, every feature of the East Jefferson Water Plant was carefully selected with the one aim of obtaining optimum accuracy of operation plus wide-range flexibility of control. The completed plant is an integrated machine, capable of precise adjustment to meet seasonable fluctuations in raw water and variations in water demand.

Omega Machine Company is proud of the fact that its Loss-In-Weight Gravimetric Feeders were selected for this plant. These highly accurate feeders, installed by E. W. Bacharach, Inc. of Kansas City, Mo., deliver the coagulating and pH control chemicals required in the treatment process.

For Bulletins describing Omega Water Works Equipment, address Omega Machine Company (Division of Builders Iron Foundry), Providence 1, Rhode Island.

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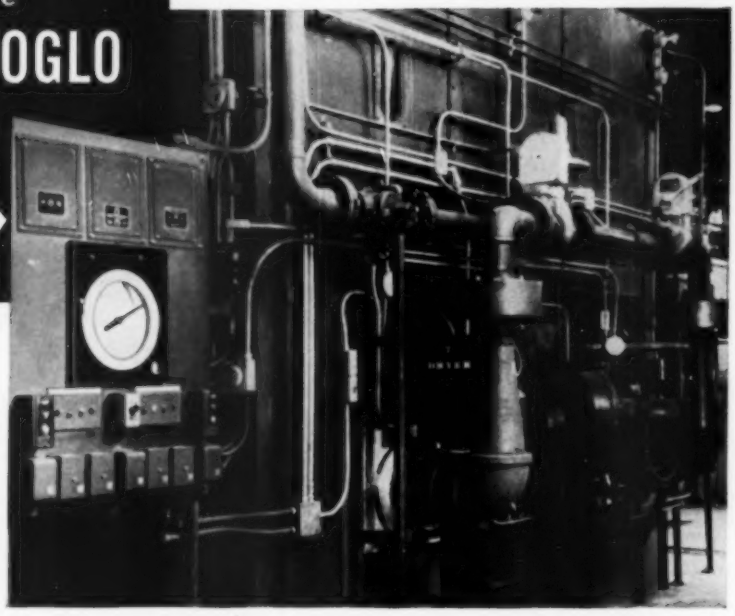

Three Protectoglo units safeguard combustion in dryers in a large municipal waste treatment plant.

THE DANGERS of flame failure in incinerators, dryers and other fuel-burning equipment are completely and dependably eliminated with the *Protectoglo* combustion safeguard. The instant the flame goes out . . . or fails to ignite . . . it automatically prevents further flow of fuel.

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It's flexible, too! The safeguard is applicable to single or multiple burners . . . to main flame or pilot flame supervision . . . or to sequence supervision of pilot and main flames. It can be used as a straight cut-off device, or it can operate an automatic re-light.

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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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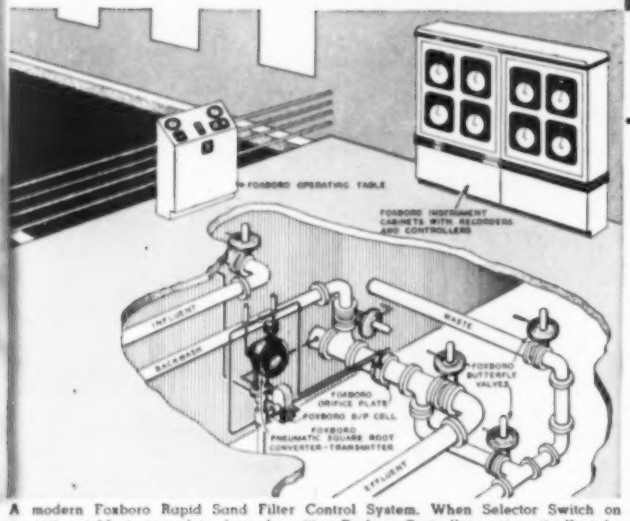

A modern Foxboro Rapid Sand Filter Control System. When Selector Switch on operating table is turned to desired position Foxboro Controllers automatically take over operational control of valves.

...a "foolproof" system that is easier to install, to operate, and to maintain

The New Foxboro Rapid Sand Filter Control System combines maximum operating convenience with a minimum of maintenance. Its all-pneumatic transmission and control eliminates drums, cables, and pulleys . . . makes possible remote operation of valves without high pressure piping to the control panel.

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All connections are made with ¼" copper tubing. Hence, installations with remote setting of flow rates . . . and with supplementary remote indication . . . are simple and economical.

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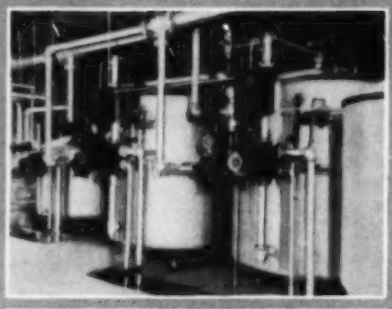

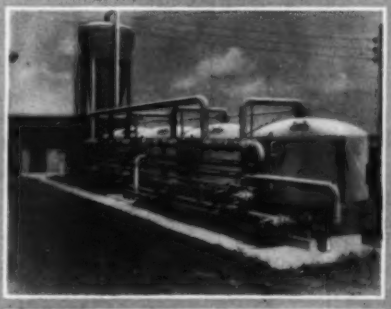

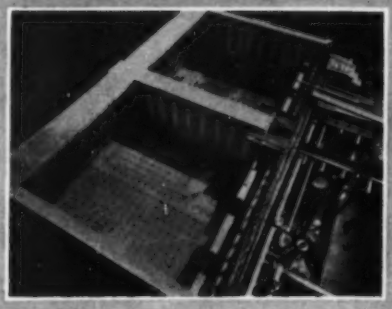

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. . . ideal for sewers

For more than 100 years engineers have depended on concrete pipe for sanitary sewers. It has (1) strength to resist severe impact and sustain heavy overburdens, (2) durability to render long years of trouble-free service, (3) economy that assures maximum value per tax dollar invested.

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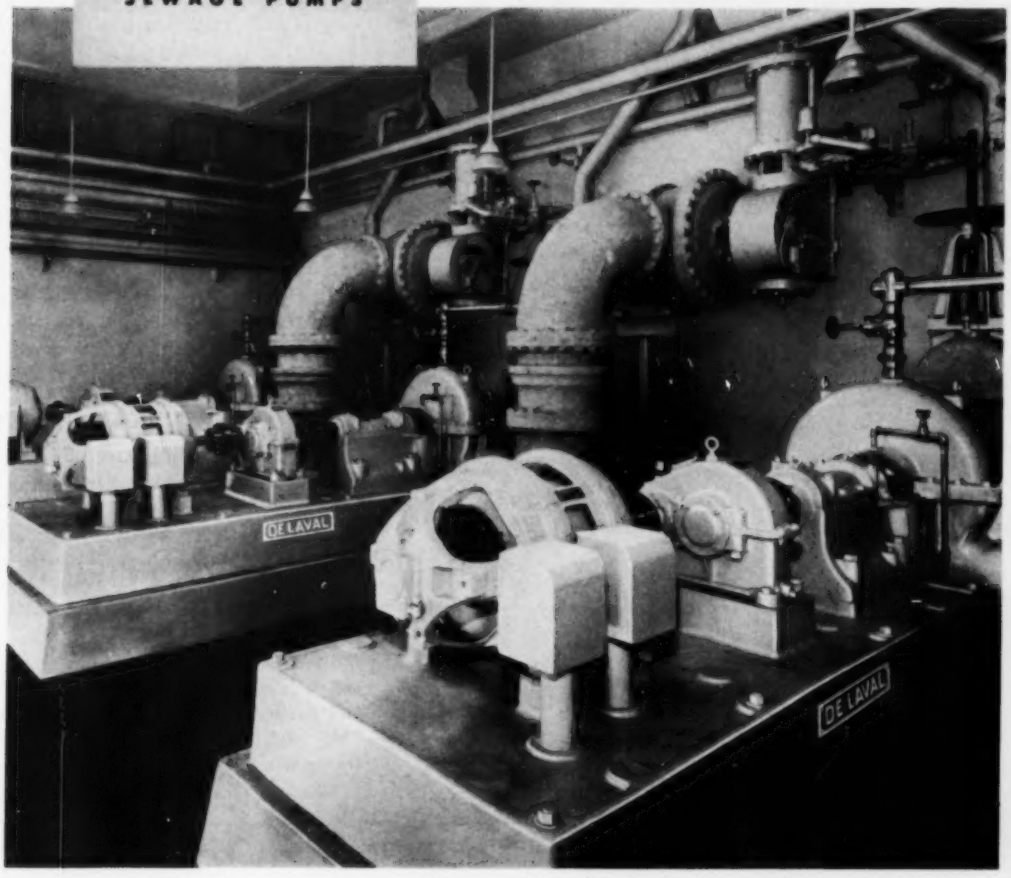
DE LAVAL SEWAGE PUMPS *serve Baltimore's new plant*



Three De Laval sewage pumps are on the job in the City of Baltimore's new Brooklyn Sewage Pumping Station built for today's need and planned for future expansion.

Two of these high efficiency motor-driven horizontal pumps have a capacity of 3,000 gpm and the third has a capacity of 7,000 gpm. Later, as flow increases, the two 3,000 gpm units can be replaced by a 7,000 gpm pump.

Slow speeds of these De Laval pumps insure long life, large passageways reduce clogging and nickel-chrome cast iron casings and impellers assure long wear.

Baltimore is another of a long list of cities being served by De Laval pumps. A complete centrifugal pump line is built on 50 years experience at De Laval—pioneer in the municipal pumping field.

DE LAVAL *Sewage Pumps*

DE LAVAL STEAM TURBINE COMPANY
Trenton 2, New Jersey

D-L-121

Carlon Water Service Pipe

Now ... CARLON "WS" corrosionproof plastic pipe offers new advantages for municipal water system service connections. It is easier to handle, faster to install and lasts longer than any metallic pipe.

CARLON weighs only ⅛th as much as steel pipe — requires no rigging equipment. Being flexible, it can be curved to follow irregular contours or ditch lines. It is furnished in long lengths which require fewer fittings, and fitting make-up can be done in a matter of minutes. Special connecting fittings for corporation stops and meter yokes are available.

CARLON ends costly periodic replacement of water lines because of electrolytic corrosion or interior build-up. It is the only pipe that is guaranteed against rot, rust and electrolytic corrosion! Smooth internal wall will not accumulate scale or sediment — assures permanent free-flow.

Complete line of molded plastic fittings makes possible all-plastic installations and facilitates connection of CARLON "WS" pipe to previously installed metallic systems.

Nominal Pipe Size	O.D.	I.D.	Working Pressures P.S.I. @ 120°F.	Weight Per Foot	Normal Shipping Lengths
¾"	1.170	.824	120	.216	400' coils
1"	1.433	1.070	120	.285	300' "
1¼"	1.850	1.380	120	.477	300' "
1½"	2.260	1.610	120	.790	250' "
2"	3.000	2.070	120	1.88	200' "
2"	2.495	2.070	75	.620	200' "
2½"	2.950	2.470	75	.820	150' "
3"	3.670	3.070	75	1.280	100' "
4"	4.820	4.030	75	2.200	25' straight
6"	7.260	6.070	75	5.000	25' "

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686-CP

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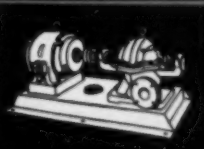
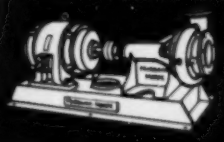


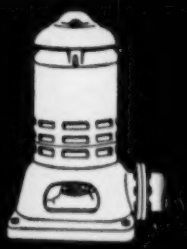
Two-Stage Centrifugal Pumps
Capacities: 100-560 G.P.M.

Builtogether
Centrifugal Pumps
Capacities: 5-1000 G.P.M.

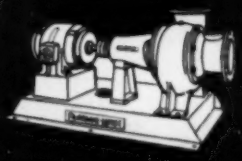
Frame Constructed
Rotary Pumps
Capacities: 1.3-450 G.P.M.



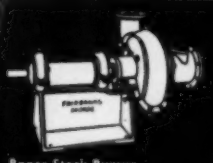
Base-Mounted Centrifugal Pumps
Capacities: 25-3000 G.P.M.



Deep Well Turbine Pumps
Capacities: 15-25,000 G.P.M.



Horizontal Angle Flow Pumps
Capacities up to 100,000 G.P.M.



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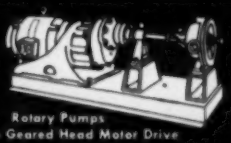
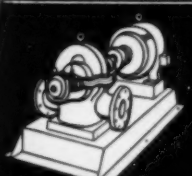
Capacities up to
2500 G.P.M.

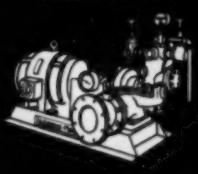


Rotary Pumps
With Geared Head Motor Drive
Capacities: 20-450 G.P.M.



Split-Case Centrifugal Pumps
Capacities: 50-50,000 G.P.M.

Two-Stage Builtogether Pumps
Capacities: 5-1000 G.P.M.



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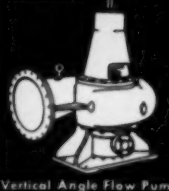
Capacities: 500-2000 G.P.M.

Bladeless Impeller
Food Handling Pumps

Vertical
Propeller Pumps
Capacities:
1250-216,000
G.P.M.

Sewage and Trash Pumps
Capacities: 50-20,000 G.P.M.



Vertical Angle Flow Pumps
Capacities up to
100,000 G.P.M.

. . . it's the new RING-TITE JOINT used with Transite Sewer Pipe

NO NEED TO LET ordinary time-consuming methods of making joints slow down your sewer line jobs—not when you install Transite* Sewer Pipe with its new Ring-Tite Coupling.

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Moreover, this easily assembled Ring-Tite Coupling makes a tight joint that *stays* tight in service. This, plus the fact that Transite's long 13-foot lengths mean *fewer* joints in the line, cuts infiltration to a minimum. As a result, treatment costs are reduced, plant capacity conserved for future needs.

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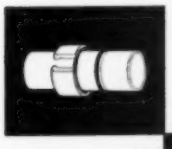
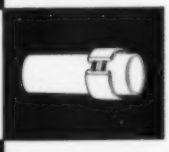
*Transite is a registered Johns-Manville trade mark

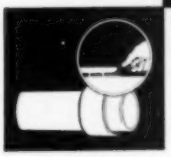
HERE'S HOW THE RING-TITE JOINT WORKS:



Start of assembly. Two rubber rings and a Transite sleeve (cut away to show position of the rings) are placed on one of the two pipe ends to be joined.



Final position. Sleeve centered over both pipe ends, with the rubber rings tightly compressed between sleeve and pipe.



Checking joint for proper assembly. This is done with a simple gauge immediately after the joint is made . . . *before backfilling.*

JM PRODUCTS

Johns-Manville TRANSITE SEWER PIPE

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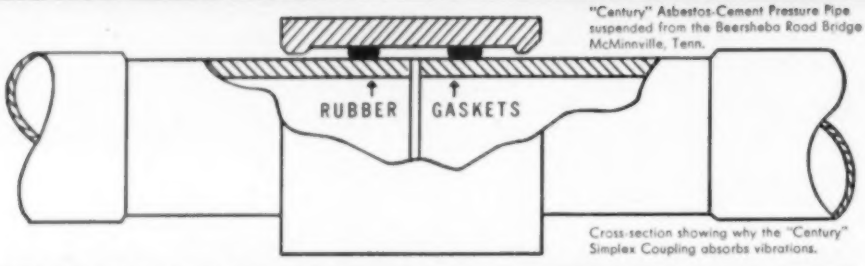
VERTICAL TURBINE PUMPS
WATER TREATMENT

"Century" Asbestos-Cement Pressure Pipe suspended from the Beersheba Road Bridge at McMinnville, Tenn.



Cross-section showing why the "Century" Simplex Coupling absorbs vibrations.

Cross your bridges with . . .

"CENTURY" asbestos-cement pressure pipe

Built for crossing bridges when it comes to them, "Century" Asbestos-Cement Pressure Pipe withstands vibration due to its inherently rugged construction and the rubber cushioning of its "Century" Simplex Couplings.

As you can see from the cross-section of the "Century" Simplex Coupling above, the pipe ends float in rubber gaskets which absorb these vibrations and the separation of pipe ends within the coupling localizes them to the individual pipe sections. Each coupling serves as an expansion joint.

Its light weight and handy lengths are easy to attach to bridge structures. Economies result because specially skilled labor is not required. It can be cut on the job, and "Century" Simplex Couplings safely allow up to 5° of deflection for each pipe length. Over the years its strength actually increases, and its smooth inner surface assures continuous maximum carrying capacity. The usual painting expense is completely eliminated.

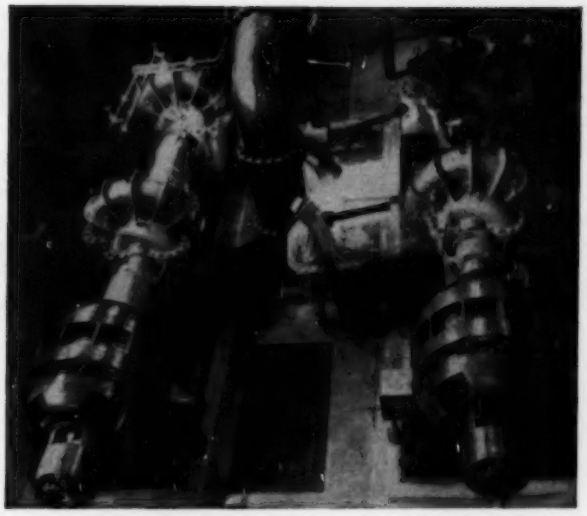
Here is high performance at low cost in water mains. Write for full data.

Write for Free Booklet, "Mains without Maintenance." Contains valuable reference material, specifications, and data for anyone interested in pipe for water mains.

Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

Worthington Serves Fort Worth Pumping Station Since 1893



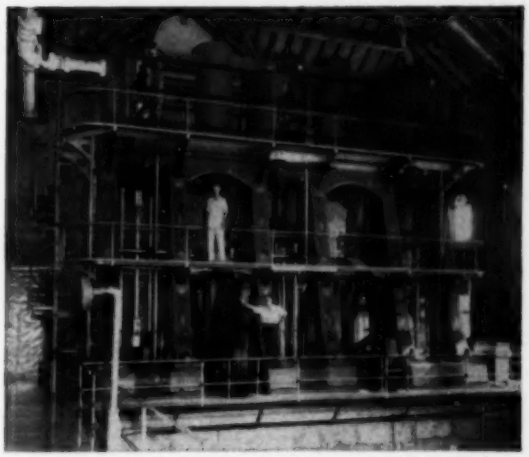
WITH NEARLY TWICE THE CAPACITY of the old triple-expansion engines formerly used, these two Worthington centrifugal pumping units can move as much as 30,000,000 gallons of water per day. Between the pumps, stands Fort Worth's Holly Pumping Station plant superintendent, Fred King, an enthusiastic Worthington backer.

Texas city again turns to Worthington for dependable pumping

After 50 years' experience with two triple-expansion Holly pumping units, the city of Fort Worth, Texas, didn't have to think twice before they installed two Worthington 15 mgd centrifugal pumping units to increase the capacity of their Holly Pumping Station.

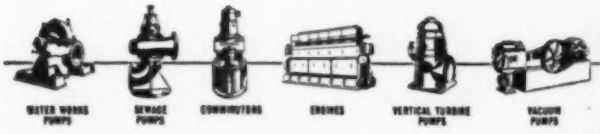
Each new unit consists of two pumps in series. Since the new installation was made, the old Holly unit has been maintained for stand-by service. Soon, this old Holly veteran will be replaced by 2 more Worthington centrifugal pumping units with a capacity of 27 mgd, bringing the total volume of water handled by Worthington pumps to 84 mgd.

The Fort Worth story is just another example of the kind of service many cities, large and small, are getting from Worthington equipment and engineering. All will testify that *there's more worth in Worthington.* Worthington Corporation, Public Works Division, Harrison, N. J.



INSTALLED IN 1893 AND STILL OPERATING, this giant Holly Pumping Engine has a rated capacity of 8,000,000 gallons per day, a pumping head of 285 ft. One of two such units, it is now used for stand-by service at the Fort Worth pumping station, but it will soon be replaced by two 27-mgd Worthington centrifugal units.

W 1.6



All Major Public Works Equipment Under One Responsibility

WORTHINGTON

Public Works Equipment

SIMPLICITY of AMERICAN METERS

MEANS A SMALLER STOCK OF PARTS

With fewer moving parts and a more simple construction than most water meters, maintenance and repair cost of American Meters is unusually low. Parts stocks are kept at the absolute minimum both for number of items and quantity of each one.

For example, all intermediate gear train parts are supplied individually. Measuring chamber halves can be replaced separately, not just as a complete factory-matched assembly. One part of an assembly replaced today must make a perfect fit with the rest of the parts though they be 20 or 30 years old.

Write for full details.

BUFFALO METER CO.

2909 MAIN STREET, BUFFALO 14, NEW YORK

HORTON ELEVATED TANK
Installed by Builders of Bunche Park

The 150,000-gallon Horton elevated tank installed at Bunche Park, Florida is providing this community with all the inherent advantages of a dependable gravity water supply.

Bunche Park is a new housing development located 10 miles north of Miami, near Opa Locka. The project covers 330 acres and contains 1,036 dwellings in which 960 families are living. The estimated population is 3,450.

Water for this development is obtained from shallow wells, treated, and then pumped into the distribution system. When more water is pumped than used, the surplus goes into the elevated tank. When more water is used than pumped some of the reserve in the tank flows back into the mains. This means more uniform pressure throughout the distribution system, a reduction in pumping costs, and a reliable reserve that helps equipment meet peak loads.

Horton ellipsoidal-bottom elevated tanks are built in standard capacities from 15,000 to 500,000 gallons. Horton elevated tanks in standard capacities from 500,000 to 3,000,000 gallons may be had with radial-cone bottoms. We also build standpipes and reservoirs of welded steel construction up to 10,000,000 gallons. For complete details or quotations, write our nearest office.

150,000-gallon Horton ellipsoidal-bottom elevated tank in water distribution system at Bunche Park—a new housing development 10 miles north of Miami, Fla., near Opa Locka.

HORTON

WELDED STEEL STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

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Whether you buy one or a thousand

HERSEY WATER METERS

you will find them uniformly accurate and dependable

HERSEY MANUFACTURING COMPANY

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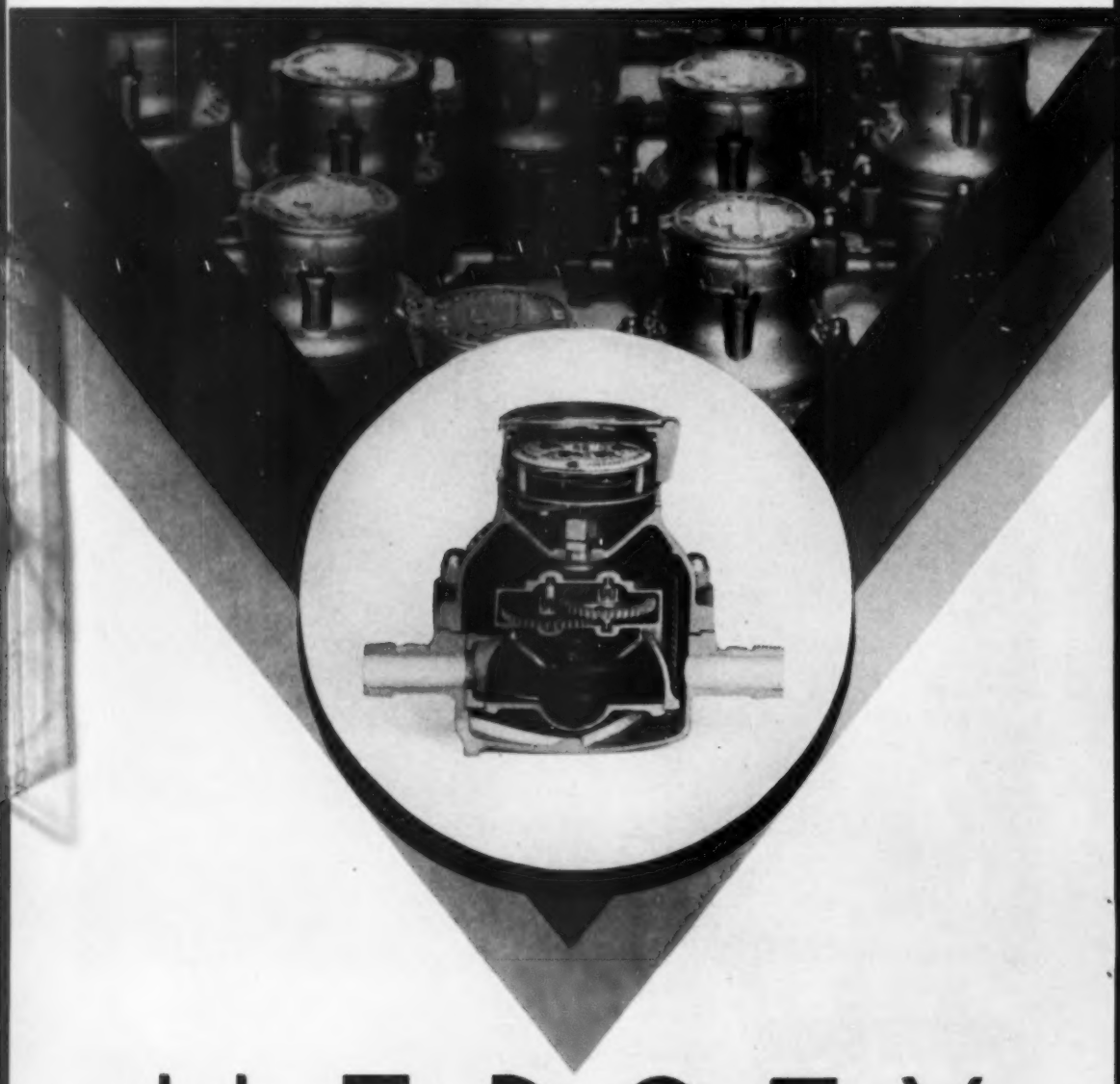
BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES



HERSEY

PITTSBURGH-DES MOINES

Elevated Steel Tanks

Removed from the ceaseless roar of Niagara, is this dependable elevated reservoir of water for the community needs of the city. The 2,000,000-gallon Pittsburgh-Des Moines Elevated Steel Tank is our low head-range Radial Cone Bottom design, 101' 0" diameter, 35' 0" head range, with height to bottom 104' 0". For full information on this and other modern Pittsburgh-Des Moines Elevated Steel Tank types, write for our new 20-page Bulletin 101.

PITTSBURGH - DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

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NEWARK (2)	218 Industrial Office Bldg.	DALLAS (1)	1223 Praetorian Building
CHICAGO (3)	1222 First National Bank Bldg.	SEATTLE	526 Lane Street
LOS ANGELES (48)	6399 Wilshire Blvd.	SANTA CLARA, CAL.	625 Alviso Road

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CYLINDER-NECK *SEASON*

Empty cylinders that we don't have are the bottle-neck hindering delivery of chlorine from us to you.

At this time of year, when demand for cylinder chlorine is heaviest, we make every effort to fill your orders promptly. But, no matter what M31 says, we cannot ship chlorine without containers.

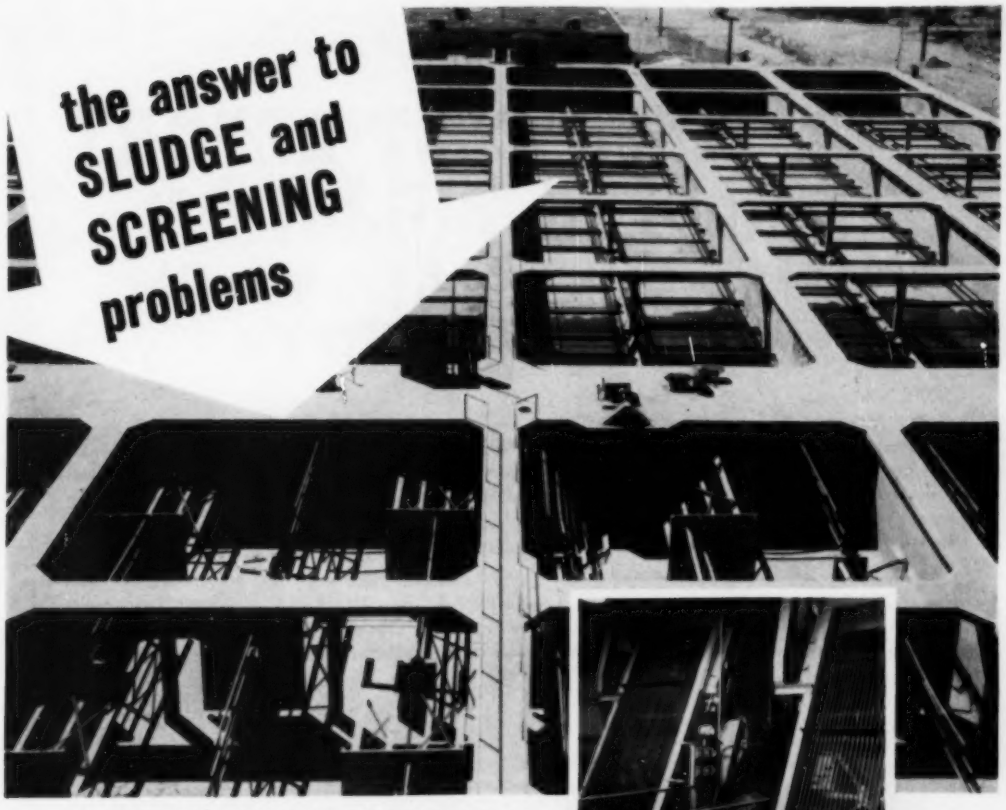
May we have your prompt co-operation in returning empties so that we can give you our best service?

CHLORINE DEPARTMENT

DIAMOND ALKALI COMPANY...CLEVELAND 14, OHIO

DIAMOND ALKALI CHEMICALS ®

the answer to SLUDGE and SCREENING problems



Jeffrey FLOCTROLS for the mixing basins and Jeffrey Sludge Collectors for the settling basins — combine to make the plant above one of the southwest's most efficient and largest (30 million gallons daily).

Insert shows two of four Jeffrey Backcleaned Fine Screens in the 26th Ward Sewage Treatment Works, New York City. Jeffrey pioneered this type of screen, has made many installations in the last eleven years.

Other Jeffrey sanitation equipment includes Grit Washers, Scum Removers, Garbage and Screenings Grinders, Chemical Feeders, Chains, etc.

Ask for Catalog No. 833

THE JEFFREY MANUFACTURING COMPANY Established 1877

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1877 75 YEARS 1952 JM

FIELD TEST REPORT

90 ppm Aqua Nuchar Reduced Raw Water Odor with a Threshold Value of 200 plus

PROBLEM:

The taste and odor condition at this Ohio town was one of the worst ever encountered by an Aqua Nuchar Threshold Odor Service Specialist. The taste and odor problem was twofold. First, the raw water had been polluted with phenol, a condition caused by a burning mine refuse heap under which the mine waste water flowed. The mine waste water, after it passed under the burning refuse heap had a 500 ppb phenol concentration which resulted in 5 ppb of phenol in the reservoir, or enough to provide a disagreeable medicinal taste in the water when reacted with chlorine.

Second, the water in the reservoir had a very disagreeable fishy taste and odor with a threshold odor value of 200 plus. Tests proved that algae did not cause the fishy taste and odor which probably was caused by a "turn-over" of the water in the reservoir due to a temperature change. When the fishy type taste and odor is present in this raw water supply, the threshold odor must be reduced to 6 to provide a palatable water supply.

SOLUTION:

Laboratory tests indicated that 90 ppm Aqua Nuchar A would be required to reduce the raw water threshold odor value of 200 to the palatable level of 6. With the application of Nuchar in the plant, only 60 ppm was required to reduce the disagreeable fishy type taste and odor in the water. Considerably less Nuchar was required to eliminate the 5 ppb phenol in the reservoir water as a taste source.

The Aqua Nuchar was first fed to the water as it passed around the baffle of the settling basin. As relatively high dosages of Nuchar A would be required to produce an acceptable water, it was decided to move the point of application to the mixing basin. This point of application provided the following advantages: 1. Increased the contact time by approximately two hours. 2. Provided better mixing of the carbon with the water. 3. The carry-over of carbon on the filters was minimized, thus avoiding filter difficulties. 4. Stabilization of sludge since the greater part of the Nuchar would settle in the settling basin. 5. Moved the feeding facilities within doors to insure more prompt attention even in inclement weather.

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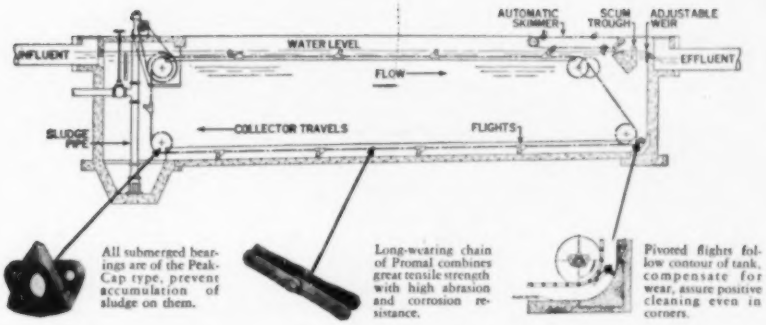
SEE OUR EXHIBIT — SEWAGE WORKS & INDUSTRIAL WASTES ASSOCS. — OCT. 6-9 — NEW YORK CITY

LINK-BELT Straightline Sludge Collectors help treat

2 BILLION GALLONS

of sewage per day


AUTOMATIC SKIMMER
SCUM TROUGH
ADJUSTABLE WEIR
INFLUENT
WATER LEVEL
EFFLUENT
FLOW
SLUDGE PIPE
COLLECTOR TRAVELS
FLIGHTS
All submerged bearings are of the Peak-Cap type, prevent accumulation of sludge on them.
Long-wearing chain of Promal combines great tensile strength with high abrasion and corrosion resistance.
Pivoted flights follow contour of tank, compensate for wear, assure positive cleaning even in corners.

Easy, economical sludge removal provided for water and industrial waste treatment plants

Since the first Straightline Sludge Collector went into service at Gastonia, N. C., in 1921, the great majority of the country's rectangular settling tanks have been equipped with this Link-Belt design. Straightline action provides the shortest possible travel of collected material at slow, uniform speed. Result: minimum disturbance of flow and maximum efficiency. In addition, they have a proven record for uninterrupted operation with minimum attention.

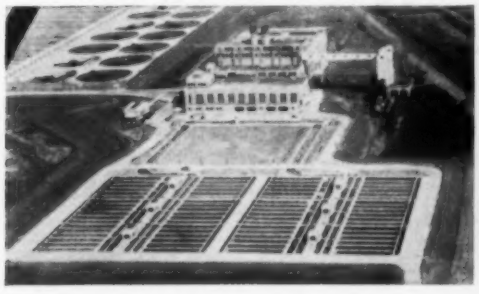
Straightline Collectors are part of the complete Link-Belt line of quality equipment. Our sanitary engineers will be glad to work with your engineers, chemists and consultants—help you get the best in modern water, sewage or industrial liquids treatment equipment.

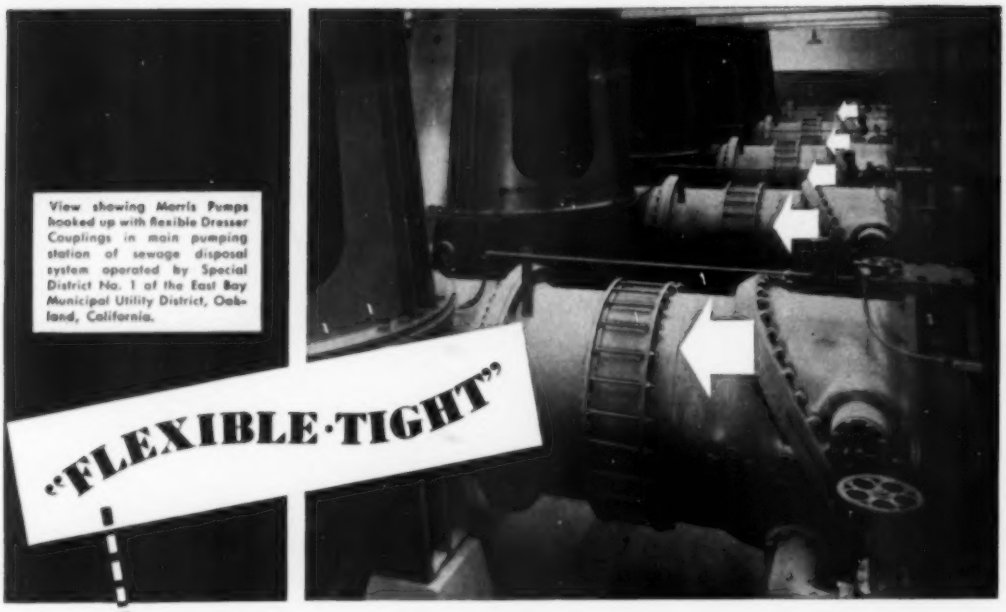
LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 12,972

Straightline Collectors, for both primary and final settling tanks, equip plants from 80,000 up to 600,000,000 gpd. Shown here: a 600,000,000 gpd plant (left) and 6,000,000 gpd (right).





View showing Morris Pumps hooked up with flexible Dresser Couplings in main pumping station of sewage disposal system operated by Special District No. 1 of the East Bay Municipal Utility District, Oakland, California.

These are profitable connections

Leading pump manufacturers such as the Morris Machine Works welcome Dresser Couplings in their pump installations because these "Flexible-Tight" joints offer four important advantages:

The Dresser Coupling compensates for any slight misalignment of the piping, permitting much simpler and quicker installation.

The coupling is a "must" for dismantling purposes. It permits easy removal and reinstallation of the spool piece.

The Dresser Coupling permits a flush internal pipe connection with minimum turbulence or eddying.

Perhaps one of the most important functions of the Dresser Coupling is to remove entirely any piping strains on the pump casing, avoiding danger of destroying the alignment of the pump.

All these advantages stem from the fact that Dresser Couplings are designed to provide a "Flexible-Tight" joint that's easy to install. Resilient, long-lived gaskets harmlessly absorb stresses and strains, protecting pipe and equipment. Proved in use for more than 60 years.

Write today for more information about Dresser applications on water, sewage, and industrial waste projects.

These 67" air mains at the Sanitary District Sewage Works, Chicago, are Dresser-Coupled to provide complete dependability. Leaks could not be tolerated. A fraction of a pound saved in air pressure meant dollars saved in electric power costs. Dressers were selected to assure that saving.

DRESSER

"FLEXIBLE-TIGHT"

COUPLINGS

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: 629 Adelaide St., W., Toronto, Ont.

Doing a Good Turn for the Community

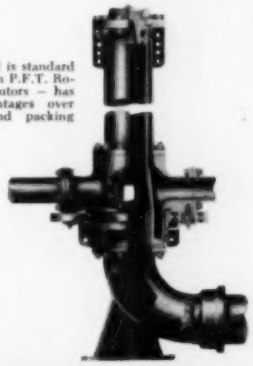
P.F.T. Rotary Distributors are available to meet the needs of any community. One of twenty 165' dia. units at Dayton, Ohio shown above — Two 100' units at Collinsville, Ill. Other units from 28' dia.

At sewage treatment plants where lack of head and maximum utilization of space are governing factors, the P.F.T. Rotary Distributor meets the need. In literally thousands of installations they are doing a good turn for the community by providing uniform distribution of sewage over the entire filter bed area, assuring fullest utilization of the filtering media.

Here again sound P.F.T. Engineering is evident in the design and construction materials used. Built for all-weather, maintenance-free operation, P.F.T. Rotary Distributors have established a splendid performance record.

Highlight of design is the patented P.F.T. Spreader Jet which fans out sewage depositing it in a thin layer on the filter bed, so that percolation is quickly effected. Data and list of installations available.

Mercury seal is standard equipment on P.F.T. Rotary Distributors — has many advantages over air lock and packing gland seals.



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Waste Treatment Equipment Exclusively Since 1893

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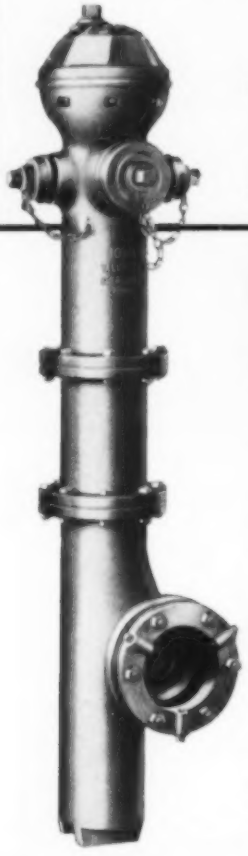

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MECHANICAL JOINT HYDRANTS and GATE VALVES

Hundreds of Waterworks Engineers and Superintendents across the nation are switching to Iowa Mechanical Joint Fire Hydrants and Gate Valves.

Recognized design, combined with superior quality and workmanship, assures maximum efficiency and positive operation. "Bottle-tight" Mechanical Joints provide fast economical installations and speed completion of construction projects.

Iowa Mechanical Joint Fire Hydrants and Gate Valves conform in every respect to latest American Water Works Association specifications.

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JAMES B. CLOW & SONS

Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A.N.A.

CAST IRON PIPE—so well known for its long life and widespread use in community water, gas and sewerage systems—also has diversified uses in various industries. The volume of water, gas and waste handled by many industrial plants is often equivalent to that of a good-sized city.

U. S. cast iron pipe for community or industrial service is cast centrifugally in metal molds in sizes 2-inch to 24-inch with bell-and-spigot, mechanical joints or plain ends. All our cast iron pipe larger than 24-inch and smaller pipe with flexible or integral flange joints are made by the pit cast process. With both manufacturing processes modern control methods are employed to assure a quality product—cast iron pipe that will satisfactorily and economically meet your requirements.

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PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

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...A LONGER LIFE

In 1943, a small New England town was faced with the problem of replacing a condemned 57 year old water tank. Serious leaks had begun to develop in 1935, and had continued despite applications of various coatings over a period of 8 years. It was finally decided to replace the tank because of its leak record, though the cost was high.

It was then that the Electro Rust-Proofing engineer was called in. After careful examination of the entire structure, he recommended that cathodic protection equipment be installed at a fraction of the tank's replacement cost.

Since then, no further leaks have been observed, and it is felt that the tank, protected by Electro Rust-Proofing cathodic protection, may be kept in operation indefinitely.

Why not give *your* buried or submerged metal structure a longer life? A letter today may save your tank tomorrow.

COMPLETE CATHODIC PROTECTION SERVICE •
DESIGN
ENGINEERING
MAINTENANCE
INSTALLATION
EQUIPMENT

E-22

ELECTRO RUST-PROOFING CORP. (N. J.)

BELLEVILLE 9, NEW JERSEY

REPRESENTED IN PRINCIPAL CITIES IN THE UNITED STATES

Over 15 years of Cathodic Protection Engineering, Research and Development

30% LESS SLUDGE...

Sludge Bed Dries in Weeks Instead of Months ...with ENZYMATIC Treatment!

Drying bed of the Oakland, Missouri Disposal Plant, where Enzymatic boosted drying time to an "unbelievably rapid rate". City officials say, "Enzymatic is the most remarkable product we have ever tested . . . economically solves every problem our disposal system faced."

Drying Time Before:
14 WEEKS!

Drying Time With
ENZYMATIC:
14 DAYS!

Communities Report Astounding Results with New ENZYMATIC Product in Sewage Treatment Plants.

ENZYMATIC IS PERFORMANCE GUARANTEED!

- Completely eliminates or greatly reduces odors
- Reduces amount of sludge at least 30%
- Increases gas production—keeps it steady
- Liquefies and permits digestion of fats
- Makes sludge free-flowing
- Cleans spray nozzles—keeps them open
- Eliminates need for standby heating and fuel purchases
- Speeds sludge drying—to weeks instead of months
- Prevents "flop-over" and "sloughing off"

MAKE YOUR OWN TEST OF ENZYMATIC. Prove to your own satisfaction as hundreds of cities have done. Enzymatic is sold on a *performance guarantee.*

N. O. NELSON
Company
SAINT LOUIS, MISSOURI

SEND COUPON FOR COMPLETE TECHNICAL INFORMATION!

To: N. O. Nelson Co., P. O. Box 3265, Dept. F, St. Louis 10, Mo.

Gentlemen: Please send me full details on Enzymatic.

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Company.....

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Address.....City.....Zone.....State.....

In 24 of America's large cities and scores of smaller towns, Rensselaer valve equipment has been used satisfactorily for 50 years or more.

Such records of performance and repeat orders cannot be accidental. They are due to the fact that all Rensselaer products are over-safe, both as to generous amounts of materials in the right places, and the incorporation of design features which insure reliable performance years after the valves are installed.

103

Rensselaer VALVE COMPANY, TROY, N. Y.

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES • CHECK VALVES • AIR RELEASE VALVES

A SUBSIDIARY OF NEPTUNE METER COMPANY

Sales representatives in principal cities

AVAILABLE NOW!

The first motion picture on SNOW MELTING SYSTEMS

Now, for the first time, you can actually see these modern snow removal systems in operation. In the last few years, a great amount of material has been written and published on snow melting systems, but our new film, "A Winter Wonder," takes you "on location" and shows you how Byers Snow Melting Systems came through recent winter snowfalls in a wide variety of applications.

This professionally-produced film reviews the entire snow melting subject from installation to performance. You'll see how coils of Byers Wrought Iron pipe, embedded in concrete, and carrying hot water-anti-freeze solution, brought hazard-free surfaces to sidewalks and driveways of private homes, commercial buildings, industrial plants, service stations, and many others. In addition to these interesting scenes of "snow melting at work," you'll watch actual operation of installing, welding, and covering prefabricated grids of genuine wrought iron pipe.

Based on the greatest pool of engineering experience on snow melting in existence today, "A Winter Wonder" has been developed as a service to the designer, fabricator, contractor and building engineer. If you share today's widespread interest in snow melting systems, you'll find the practical and factual material in this film both interesting and helpful.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

CUT OUT AND MAIL THIS COUPON TODAY!

Please send me at once:

- ☐ Your descriptive folder on how to apply for a showing of your 16 mm sound motion picture "A Winter Wonder"
- ☐ Your bulletin, BYERS WROUGHT IRON FOR SNOW MELTING SYSTEMS

Tear out this coupon, attach it to your letterhead, sign your name and title and mail to:

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TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Sewage Treatment
the ACCELO FILTER way

recovers water for irrigation use

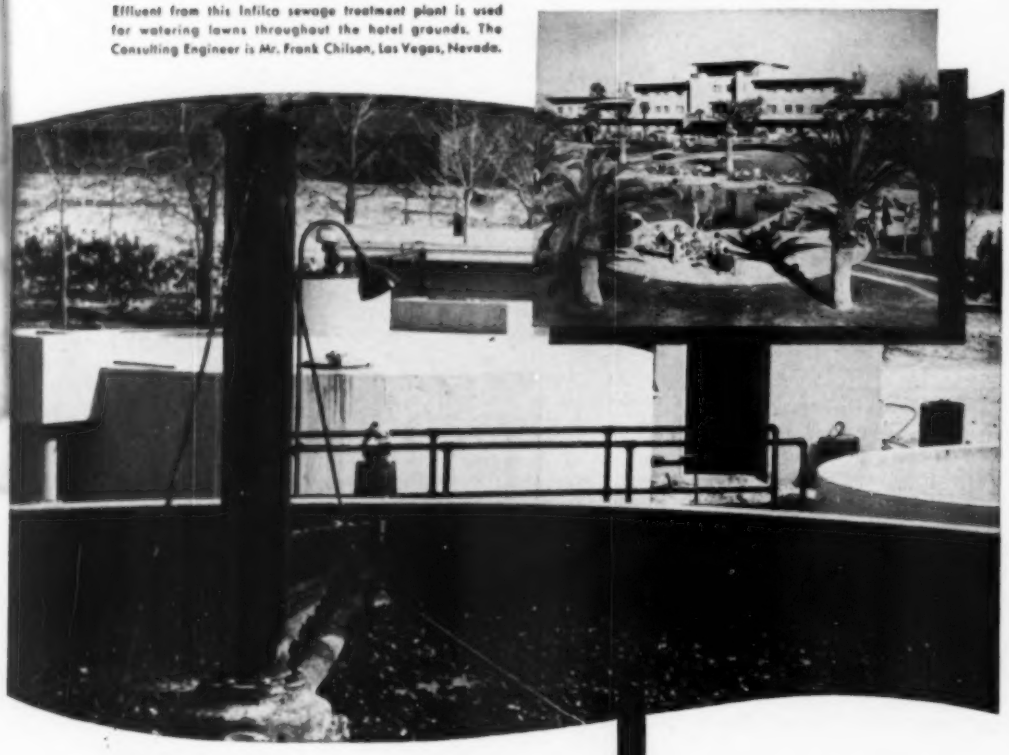
HOTEL FLAMINGO
Las Vegas, Nev., uses Accelo Filter effluent pure enough for re-use...with substantial savings in irrigation cost per year.

MANAGEMENT PROBLEM: The hotel needed an economical method of sewage treatment. Water expense demanded re-use of effluent for maintaining lawns and gardens, to conserve precious water supplies.

CONSULTANT RECOMMENDATION: Installation of Infilco equipment capable of low-cost operation and with assurance of offense-free effluent. The equipment is located near the hotel and includes a Griductor®, a primary Clarifier with automatic hydraulic skimmer, two stage Accelo® Filters with Infilco Rotary Distributors and a final Clarifier to produce a clear odorless effluent.

FOR COMPLETE INFORMATION about Infilco sewage treatment equipment write for illustrated bulletins: Griductor 5100-A; Accelo Filter 6200; Clarifier 6000.

Effluent from this Infilco sewage treatment plant is used for watering lawns throughout the hotel grounds. The Consulting Engineer is Mr. Frank Chilson, Las Vegas, Nevada.



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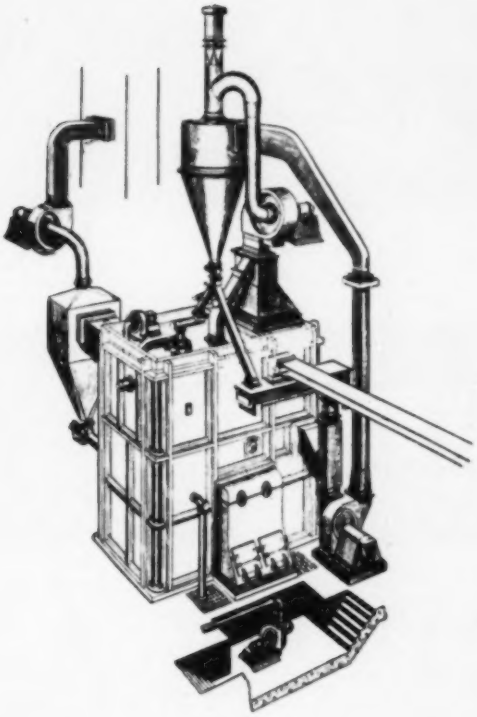

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Chicago, Ill. (W. Southwest)	City Engineering Dept.
Fond du Lac, Wis.	Jerry Donohue Engrg. Co.
Houston, Texas	Greeley and Hansen
Lansing, Mich.	Drury, McNamee and Porter
Los Angeles, Cal.	Metcalf and Eddy
San Diego, Cal.	Frank Currie
San Francisco, Cal.	Clyde C. Kennedy
Schenectady, N. Y.	Havens and Emerson
Sheboygan, Wis.	Jerry Donohue Engrg. Co.
Washington, D. C.	Greeley and Hansen
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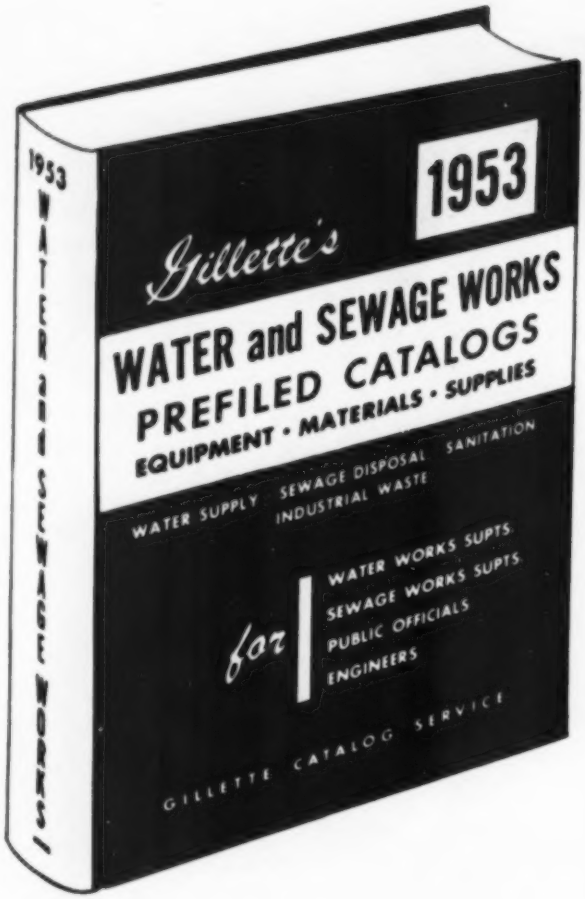

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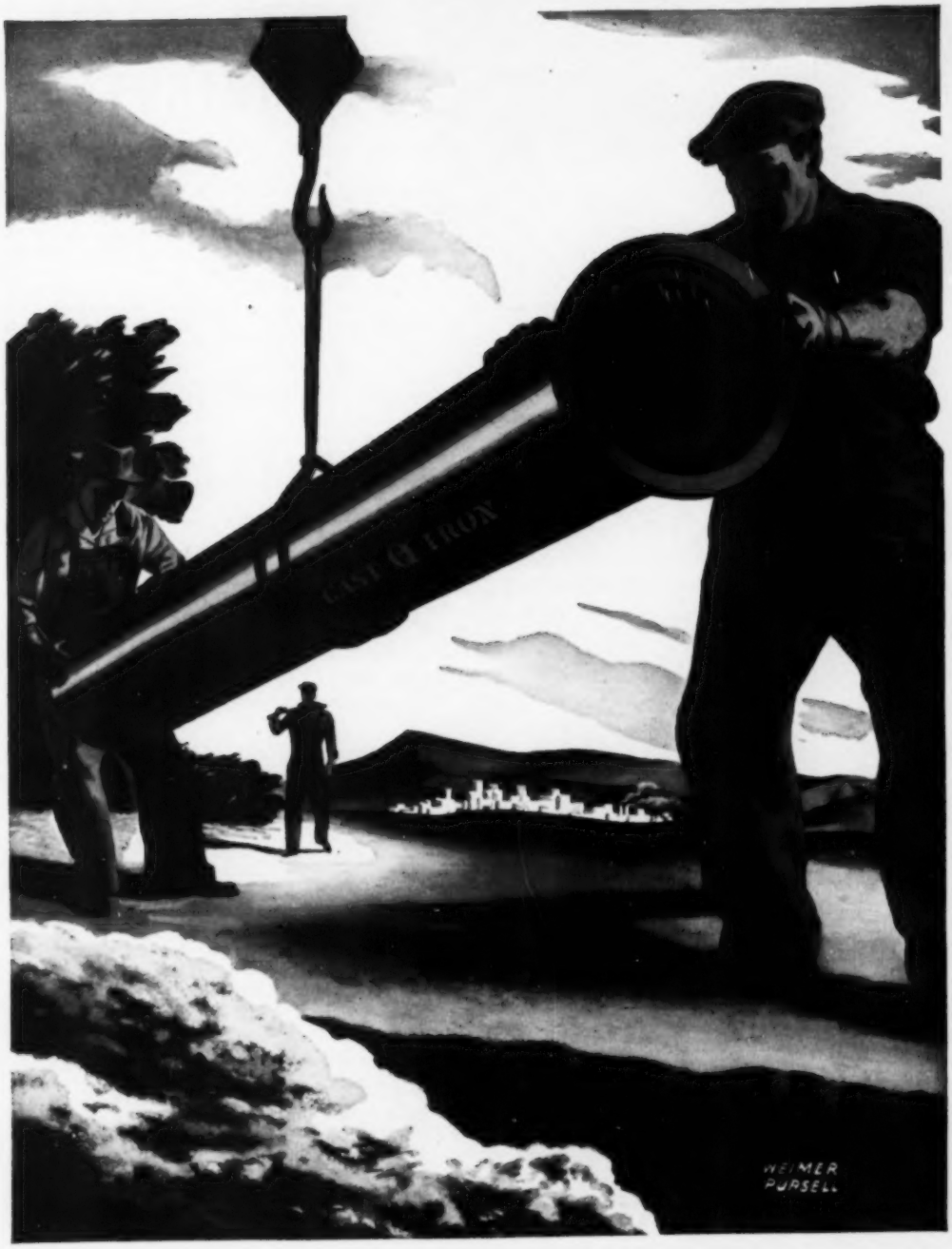

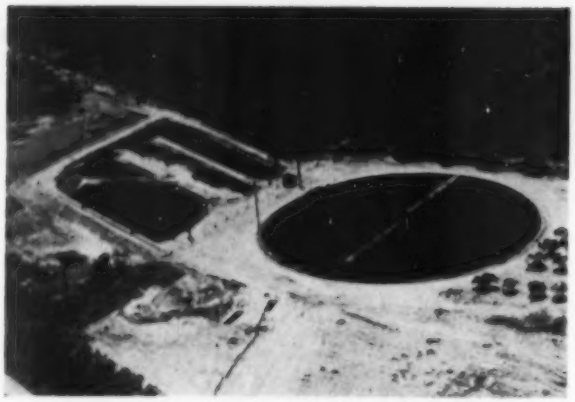

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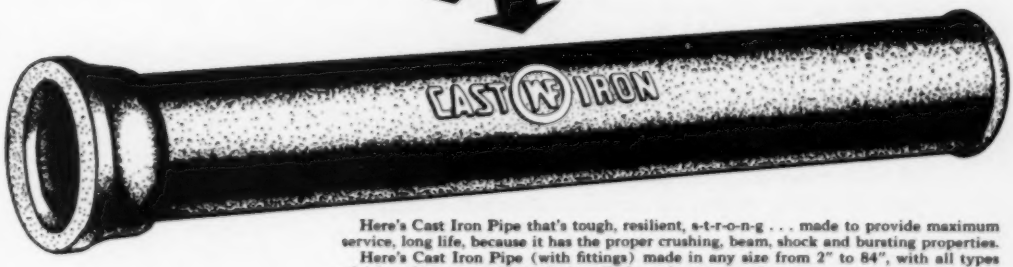

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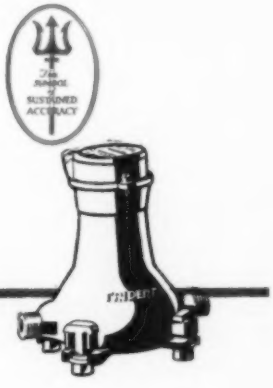
A combined daily total of more than 2 BILLION gallons of water is being needlessly pumped by American water utilities.

Much of this daily waste or leakage could be controlled by meters and adequate meter maintenance. In addition, the amount of chlorine and coal used daily to treat and pump this water would be saved.

Reports from metered communities show that metering gives increased revenue, through closer accounting for water pumped. Records prove that one of the most effective ways to minimize water waste is metering—plus systematic inspection, testing and repair, especially of domestic meters neglected for years. The first step in reducing water waste, then, is to select the right type of meters—Trident Meters—the meters that keep their initial accuracy longest, and are easiest to repair when at long last repairs are needed.



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WATER & SEWAGE WORKS

VOL. 99, NO. 9 • A GILLETTE PUBLICATION • SEPTEMBER 1952

Fort Worth's Water Works - 1952

$19,600,000 Improvement Program Nearing Completion.

by UEL STEPHENS, *Director, Department of Water Supply, Fort Worth, Texas*

A FEW far-sighted business leaders and engineers of Fort Worth were planning an adequate water supply for their city even prior to 1930. This timely planning resulted in the construction of two dams on the West Fork of the Trinity River. On April 6, 1932 the Lake Bridgeport Dam was completed and placed in service. This was followed on February 28, 1934 by the completion of and placing in service the Eagle Mountain Lake dam. Thus, by 1934 Fort Worth had a raw water supply of 531,660 acre feet.

Between 1934 and 1944 little was done to enlarge and improve the remainder of the water system consisting of the filtration works, pumping plant, elevated storage, and distribution system. Small bond issues were authorized from time to time and some small specific improvements were made but there had not been prepared a comprehensive master plan by which a large scale expansion program could be undertaken. Early in 1944 the need for such a plan was fully realized. In 1945, the engineering firms of Black and Veatch of Kansas City, and Freese and Nichols of Fort Worth were employed to make a comprehensive report on the water and sanitary sewer systems and recommendation for an improvement program which would provide adequate water and sewer service until about 1970. Among other things, the report recommended that for distribution, high service pump station and storage, there be provided $2,776,150 which, in addition to the $3,000,000 in bonds voted in 1945, but not sold, should be spent for the planned improvements during the period from 1947 to 1969. The report also anticipated a maximum hourly pumping rate of 63.5 MGD by 1970. However, on August 7, 1947 the pumping rate had already reached 66.3 MGD—some 23 years ahead of schedule.

When our current improvement program is completed in 1954 some $19,600,000 will have been spent for capital improvements during the 7 years between 1947 and 1954, and if the present rate of growth continues it will be necessary in 1954 or 1955 to launch another capital improvement program which will involve between $12,000,000 and $20,000,000. By the summer of 1953, the installed rated capacity of the main pumping plant will be 156 MGD which will be increased to 180 MGD at some future date. Thus, it is seen how greatly the growth of Fort Worth has exceeded the expectation of the consulting engineers when their studies were being made as late as 1945 and 1946.

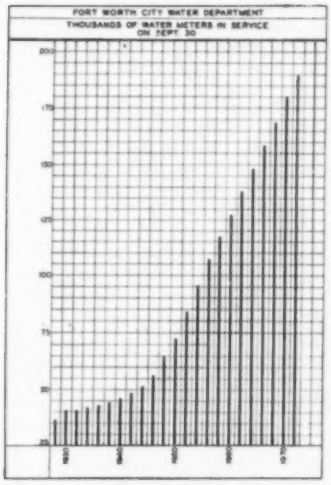


Fig. 1—GROWTH of water meters in service in Ft. Worth—past, present and projected.

Meters Become Valuable Yardsticks

From 1925 to 1945, the increase in population and water consumption of Fort Worth followed a normal pattern. The actual increase subsequent to 1945 and the presently predicted increases for the foreseeable future are almost phenomenal. Since Fort Worth's water service is 100% metered, the trend in the number of meters in service and the water used annually is a fairly accurate yardstick for determining the plant capacities which will be required to serve the community's needs. Our studies indicate that 3.8 people per water meter is a factor which can be used in making fairly accurate population estimates.

The two graphs, (Fig. 1 and Fig. 2) showing the number of meters in service as of Sept. 30th of each year

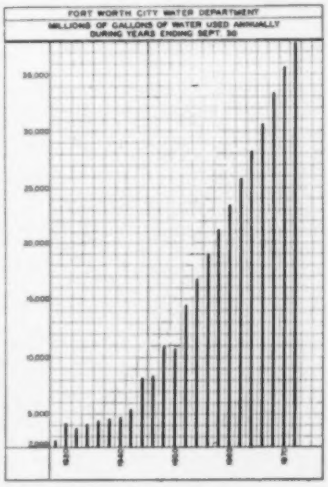


Fig. 2—GROWTH of water use year to year in Ft. Worth—past, present and projected.

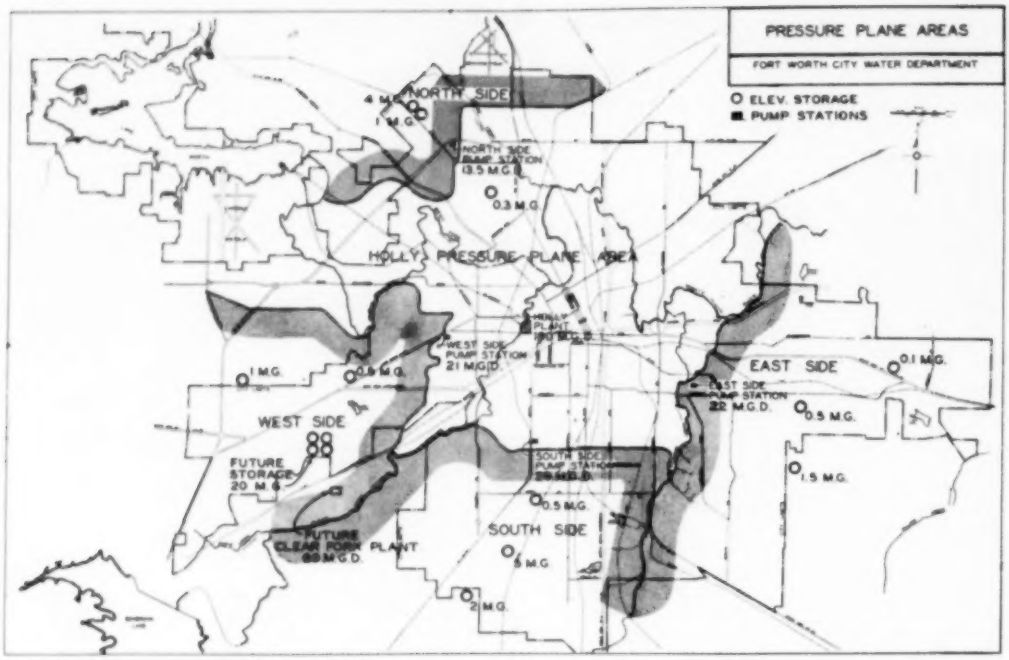


Fig. 3—PRESSURE PLANES in five area of the City of Ft. Worth. Normally these areas are operated as five separate distribution systems tied together as a major system. Note the number and distribution of elevated storage tanks and the four booster pumping stations.

and the million gallons of water used annually during each year ending Sept. 30th, are being used as the basis for planning the water system improvements. In the past we have found that it is almost impossible to build facilities large enough to more than meet the needs by the time they are completed. Consequently there has been little, if any, reserve capacity.

In planning Fort Worth's improvement program consideration had to be given to the increasing amount of water used per capita as well as the growth in population. The records indicate that in 1931 the water used per meter during the entire year was 100,900 gallons. By 1951 this had increased to 171,300 gallons and by 1971 will likely be above 200,000 gallons. This is roughly 150 gallons per capita per day.

Systems Within a System

The surface elevations of Fort Worth vary from 550 feet to 810 feet with approximately 90% of the area being below elevation 760. Due to the great area covered by the water distribution system, and the variation in elevation of some 260 feet, it became necessary to divide the city into several pressure plane areas which are shown on the accompanying Pressure Plane Area Map—(Fig. 3)—which together with the Hydraulic Gradient Diagram—(Fig. 4)—present a clear picture of the basic hydraulic features of the pumping, storage, and distribution system. Except for the water supply derived from Lake Worth on the West Fork of the Trinity, the Fort Worth water system in reality is five separate systems. The pumping stations serving the four outlying areas, i.e., South Side, (29mgd) West Side, (21mgd) North Side, (13.5mgd) and East Side, (22-mgd) are actually booster stations which take suction from large distribution mains radiating outward from the central Holly Plant. The area served by each booster stations has its own distribution system and elevated storage facilities and thereby, is a complete area water system within the major system. Connections exist in the distribution systems between the Holly pressure plane and the higher pressure plane areas, but normally the systems are separated by closed gate valves or check valves, and operate automatically and independently.

A typical high pressure plane area pump station (Booster Pump Station) is pictured herewith. Complete, comfortable and modern living quarters are provided in each of the four such pump stations. Thus, a modern home is furnished for the operator and his family. This arrangement enables the operation of a pumping station by one operator or attendant who is on duty at all times. As the pump stations are entirely automatic in operation, with the pumping units being cut in and out of service by remote pressure controls between the base of the elevated storage tank and the pumping equipment, it has been found that an elderly couple having few social obligations is ideally suited as the station attendants.

Elevated Storage

The 2 M.G. elevated tank pictured herewith, built in 1949 at a cost of $252,200, and the 1 M.G. tank, also erected in 1949 at a cost of $174,370, are amongst the seven elevated tanks scattered through the distribution system. Since 1945, with four new tanks added to the system, distribution storage has been increased from 2.03 million gallons to 16.33 million gallons as follows:

Holly Pressure Plane Area:	
4.0	M.G. North Side Concr. Reservoir
5.0	M.G. South Side Concr. Reservoir
0.33	M.G. North Side Concr. Reservoir
9.33	Million Gallons

TYPICAL of the four booster pumping stations. This is the 22mgd East Side Sta. Others are South Side (29mgd); West Side (21 mgd); North Side (13.5 mgd). The main (Holly) station will shortly have 156 mgd capacity, with 180 mgd projected.

SOUTH SIDE HIGH PRESSURE AREA:
*2.0 M.G. Seminary Hl. Elev. Steel Tank
0.5 M.G. Berry Street Elev. Steel Tank
2.5 Million Gallons

WEST SIDE HIGH PRESSURE AREA:
*1.0 M.G. Ridglea Elev. Steel Tank
0.5 M.G. Arlington Hts. Steel Tank
1.5 Million Gallons

NORTH SIDE HIGH PRESSURE AREA:
**1.0 M.G. Northwest Elev. Steel Tank

EAST SIDE HIGH PRESSURE AREA:
**1.5 M.G. Tarrant Rd. Elev. Steel Tank
0.5 M.G. Miller Street Elev. Steel Tank
2.0 Million Gallons

*Erected 1949. **Erected 1951.

Central Pumping Facilities

Prior to 1945 the rated pumping capacity of the Holly Plant was 50 MGD but under adverse head condi- which prevailed during the summer peak periods, about 45 MGD was the total output of the station. A program was commenced in 1945 of improving the discharge conditions by constructing larger mains leading away from the station and at the same time increasing the pumping capacity by installing more and larger pumping units. The original Holly Pump Station, constructed in 1892, contained two 8 MGD Holly steam triple expansion vertical type pumps, one of which upon being completed by the manufacturer was shipped to the Chicago World's Fair in 1893, there assembled and kept on exhibition for several weeks before being sent on to Fort Worth for its final installation. This historic pumping unit, which stands as high as a four story building, will in 1953 be retired and removed to make space available for four 27 MGD electric driven pumping units. When the present plans for the Holly Pump Station are completed late in 1953, the rated capacity pumping against 270 feet of head will be 180 MGD, consisting of three 15 MGD and five 27 MGD electric driven slow speed centrifugal pumping units.

Since the main (Holly) pump station is located on the bank of the Clear Fork below flood stage level and the horizontal type pumps and motors are located in a pump pit below ground level, there will be installed a storm water pumping unit of the vertical type, with the driving motor well above high water, for emergency operation in case of seepage of flood waters into the pump pit.

Plans for the complete remodeling of the old pump station built in 1892 will involve an expenditure of some $1,197,000 in addition to expenditures of $153,886 which have been made since 1944.

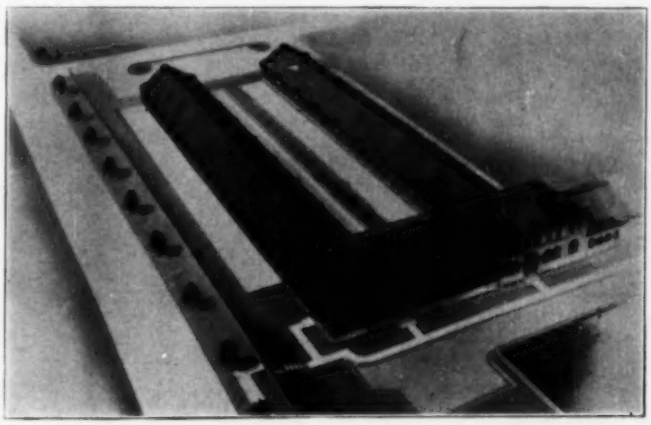
Water Purification Facilities

The Fort Worth water treatment process consists of aeration, chemical treatment with lime and sulphate of alumina, mechanical and hydraulic mixing, sedimentation, filtration, and chlorination. All of the treatment facilities have been geared to the filter plant which consists of the original building constructed in 1926 and enlarged in 1931 so as to provide a capacity of 15 MGD. At this time the first unit of a second filter building was constructed giving a total filter capacity of 35 MGD. In 1949, the second unit was extended so as to increase the capacity to 49 MGD and in June of this year the third building will be completed, increasing the rated filter capacity to 79 MGD.

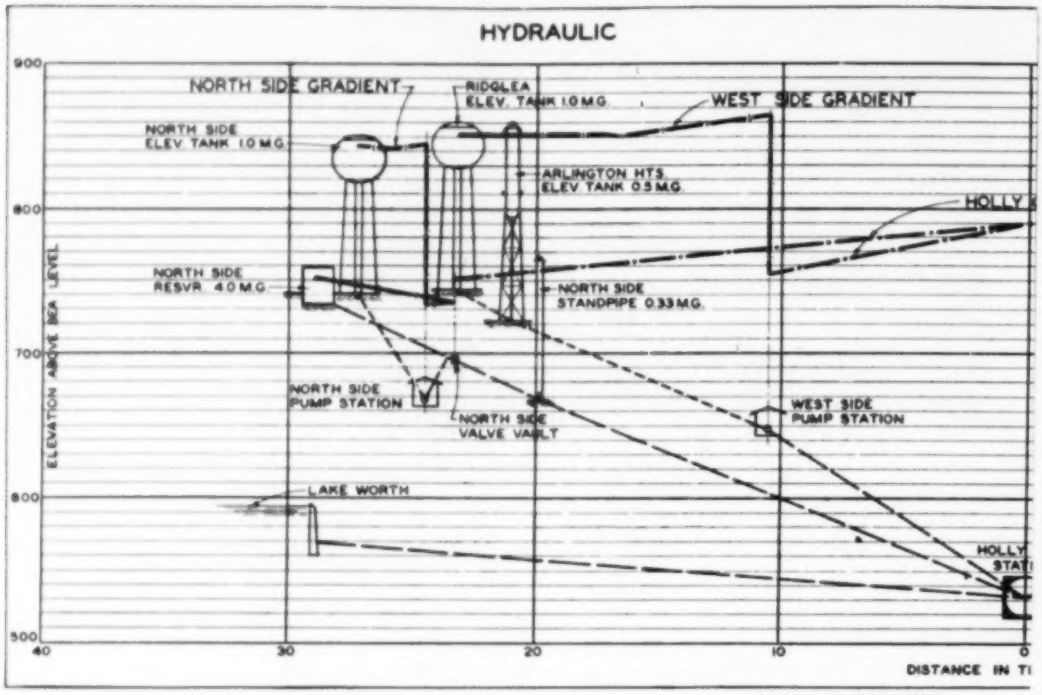
The filters are designed for 2 gallons per square foot per minute with a safe overload up to 3 gallons providing an overload capacity of the filter plant of approximately 108 GPD. The two filter buildings pictured herewith are the last two completed and have a rated capacity of 32 MGD for each wing.

Raw Water Conduits

The City of Fort Worth being located at the confluent of the West Fork and Clear Fork of the Trinity River is downstream from the storage lakes which form the water supply. The elevation of the Lake Worth spillway is 594.3 feet while the elevation of the pump shaft in the Holly Plant is 531.8 feet which enables the raw water to be taken out of Lake Worth, transported approximately six miles through one 48" and one 60" conduit to the Holly Plant, passed through the entire water treatment plant and to the storage clear wells all by gravity. The first lifting



ENLARGED portion of the Filtration Plant, which will upon completion in 1952 provide an overall capacity of 79 mgd at a 2 gal./sq.ft./min filtration rate.



HYDRAULIC GRADIENTS . . .

(Note: These gradients represent a hypothetical condition of heavy use with all

or pumping of the water is through the Holly Pump Station.

The 48" conduit from Lake Worth was built in 1914 and the 60" line was completed in 1928. The combined capacity of these two conduits was estimated to be 64 MGD but due to excessive leakage and restriction at both ends the actual capacity realized was about 45 MGD. The end restrictions were removed in 1949 and 1950 by installing an additional 48" inlet to the Holly Plant and a double barreled 60"x60" reinforced conduit through the Lake Worth dam and a new intake structure in the lake.

The third and final facility for bringing additional water from Lake Worth to the Holly Plant is the completion of a 72" pre-cast reinforced concrete pipe line for which bids will be received for the final 23,000 feet late in June.

Summary of Major Improvements

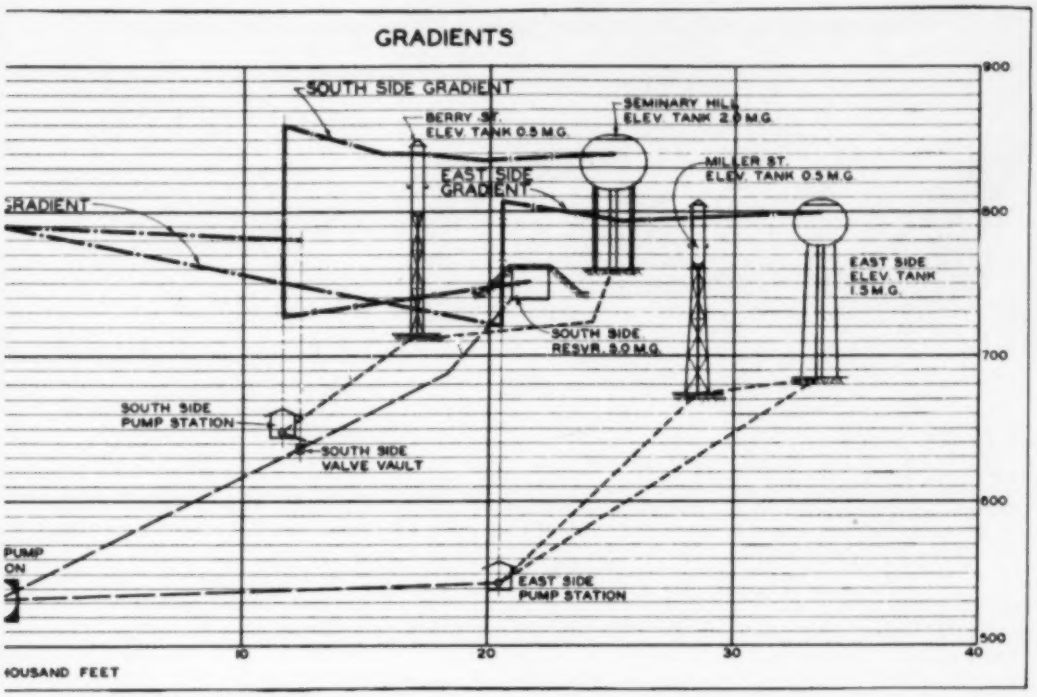
The improvement program commenced in 1945 and to be completed in 1953 may be summarized about as follows:

1. The problem was to increase all elements of the Fort Worth water system from a rated capacity of 35 MGD supplying 53,065 meters and 201,647 people to a rated capacity of 79 MGD supplying in 1955 approximately 101,200 meters and 384,560 connected population.

2. To accomplish this objective, the people of Fort Worth made available in bonds $15,400,000 and the Water Department from its operating revenue made available about $4,200,000, all of which will be invested in capital improvements between 1948 and 1953.

3. In order to plan the vast improvement program in an orderly

LARGEST of the seven elevated tanks is the South Side 2,000,000 gal. tank by Chicago Bridge & Iron Co.



. . . for four Pressure Plane Areas.
planned improvements completed and valves separating North and South Side Areas closed.)

manner and as expeditiously as possible, the engineering work was divided between three local consulting firms, i.e., Carter and Burgess, Joe J. Rady, and Freese and Nichols, with the Engineering Division of the Water Department under Mr. J. R. Hendrick, Chief Engineer, coordinating and receiving all of the plans prepared by the consulting engineers. The detail plans followed generally the recommendation contained in the overall report prepared jointly by the consulting firms of Black and Veatch, and Freese and Nichols. All construction supervision was performed by the Water Department's Engineering Division.

4. The principal projects involved in the improvement program, their objective to be accomplished, and estimated or final cost, are as follows:

a. A 72" raw water conduit from Lake Worth to the Holly treatment plant, approximately 27,000 feet in length, and improved intake and discharge conditions so as to increase the amount of water delivered to the city by 75 MGD and to cost when completed in 1953 $2,142,422.

b. Increasing the water treatment facilities from 35 MGD to 79 MGD rated capacity by the addition of chemical mixing facilities, three sedimentation basins, floctrol equipment; 45 MGD filtration capacity, 6 MG Clear Well storage, new chlorinating equipment, modernization of building and equipment and piping rearrangement, all of which will cost when completed in July of this year approximately $4,890,000.

c. Modification of the Holly Pumping Plant and installation of pumping equipment to increase the capacity from 50 MGD to 156 MGD at a cost of $1,250,886 when completed in 1953.

d. Increase elevated storage capacity from 2.03 million gallons to 16.33 million gallon at a cost of approximately $850,000 completed in June 1952.

e. Increase the distribution system by 1,200,000 feet of pipe ranging in size from 6" to 20" representing an investment of $6,675,000 between 1945 and 1953.

AMONGST NEWEST, West Side's 1,000,000 gal. tank by Pittsbg.-Des Moines Steel Co.

NEW CONDUIT of 7½ inch Lock-Joint Pipe
Conveys raw water from Lake Worth to Filtration Plant. Capacity 75 mgd.

f. Increase the booster pumping facilities from two stations having a rated capacity of 14.00 MGD to four modern stations having a rated capacity of 85.5 MGD at a cost of approximately $450,000.

g. Supply mains 24" to 48", underwater river crossings, and other items to strengthen the distribution system, approximately $3,341,000 when completed in 1953.

In Appreciation

The writer most graciously acknowledges the invaluable assistance being rendered by the Consulting Engineers—Black & Veatch, Freese and Nichols, Joe J. Rady, Carter and Burgess; Chief Engineer of the Water Department, Mr. J. R. Hendrick and his staff, and Mr. W. S. Mahlie, Superintendent of Water and Sewage Treatment, in planning the improvement program; also the splendid cooperation of the contracting firms of J. C. Williams, Inc., Cullum and Whittle, Ottinger Construction Co., Glade, Friedman & Byrne, Holtzer Construction Co., Bland Construction Co., Steed Construction Co., Glade Construction Co., Chicago Bridge & Iron Works, Pittsburgh Des Moines Steel Co., and Chief Construction Engineer for the Water Department, Mr. R. R. Lacy and his staff, for the construction and engineering supervision of the program.

Without all of this assistance and cooperation it would have been impossible to plan or construct the facilities which, when complete, will give Forth Worth a municipal water system capable of supplying the reasonable needs of a population of some 682,100 in 1970.

Uniform Accounting System for Water Works

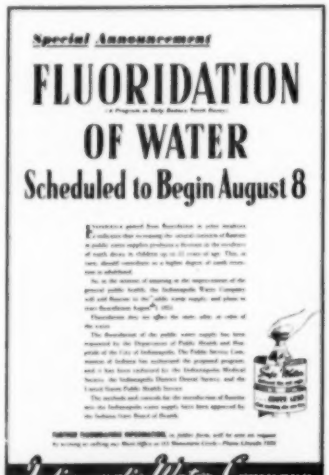
The National Association of Railroad and Utilities Commissioners' UNIFORM SYSTEM OF ACCOUNTS FOR WATER UTILITIES is again available through the Association's publishers, The State Law Reporting Company, 30 Vesey Street, New York, N.Y. The book was reprinted, the entire previous editions having been exhausted. Also available from this Company is the N.A.R.U.C.'s UNIFORM SYSTEM OF ACCOUNTS FOR GAS UTILITIES. Each book is priced at $4.00.

These Systems of Accounts were recommended for adoption and use by State utility commissions, and are used as an accounting manual and guide in accounting problems by federal, state and municipal authorities in the United States, engineers, accountants, statisticians, comptrollers auditors, treasurers, financial institutions, insurance companies, universities and colleges.

Private Water Company Sells Its Customers on Fluoridation

Theme is—"Something Has Been Added!"

Through the medium of the daily press the Indianapolis Water Co., in large space ads, told its customers that very soon the children of Indianapolis and environs, would be drinking caries preventative water. Further, that by checking tooth decay such preservation of teeth in childhood should contribute to a higher degree of tooth retention and sounder teeth in adulthood.



The accompanying is a reproduction of one of a series of such large space ads which the Indianapolis Water Co. ran prior to the commencement of fluoridation. These ads constituted a part of the regular continuing series of ads telling the people of Indianapolis how much they are getting for their dollar in the way of water supply service in contrast with other things and services that must be bought every day.

Dr. Baity Serving WHO As Director of Sanitation

Dr. H. G. Baity, Head of the Department of Sanitary Engineering, University of North Carolina, is now on an assignment with the World Health Organization as Director of Environmental Sanitation. In this capacity he will guide the development of environmental sanitation in WHO, which activity has been accorded full division status. During this period, Dr. Baity will be on leave from the University of North Carolina. Marvin L. Granstrom, Assistant Professor in Sanitary Enginering, is on leave working toward a doctorate degree in sanitary engineering at Harvard University.

To replace these two faculty members on leave, there have been appointed Colonel Jack J. Hinman, Jr., as Visiting Professor in Sanitary Engineering and Dr. Daniel A. Okun as Associate Professor in Sanitary Engineering. During Dr. Baity's leave, Emil T. Chanlett, Associate Professor in Sanitary Engineering, is Acting Head of the Department. During the months of July, August and September, Professor Chanlett will be in Brazil as consultant in sanitary engineering to the Institute of Inter-American Affairs.

Progression

Progressive thoughts can find a worthwhile resting place only in an open mind.

Water Heater Corrosion Studies

With Especial Consideration to Possible Bacterial Influences

by ROY E. DODSON, JR., *Sanitary Engineer, San Diego Water Dept., San Diego, Calif.*

THE use of automatic storage water heaters has greatly increased in the past 25 years. This is especially true in the Southwest, where practically every home is now equipped with a water heater of the automatic self-contained type. Corrosion and premature failure of the tanks has also increased as this system of domestic water heating has become more common.

In the San Diego area, water heater tanks of the automatic storage type began to fail at a rapidly increasing rate in the early 1940's. The situation appeared to be a local peculiarity because other areas, using water heaters from the same manufacturers, reported no such rapid increase in failures, although it was generally recognized that automatic storage tanks did fail more rapidly than those of the range boiler type.

By 1946, complaints were becoming frequent, from customers and manufacturers alike. The San Diego Water Department undertook a study of the possible causes of water heater tank corrosion in the area. Dozens of tanks were cut open promptly after failure and examined; analyses of the three impounded surface water supplies serving the City were compared with one another and with analyses of other supplies nearby; and an attempt was made to correlate the data with the incidence of tank failures.

All possible factors were considered, but the causes of corrosion in general water works practice were, one by one, eliminated. Stray currents, galvanic couples and inferior galvanizing were present in no greater degree than in other cities. In the water supplies themselves, the usually considered factors such as high conductivity of the water, low or negative Langelier index, hardness, dissolved oxygen and carbon dioxide content all proved to be contradictory.

Evidence finally began to point to the possibility that organic activity might be a factor. In each of the City's three water supply areas, tank failures seemed to be in proportion to the organic content of the water. The timing was also suspicious, as all of the San Diego supplies had experienced a general increase in organic content due to greatly overloaded treatment facilities, beginning in 1942.

The literature[1][2] reflected very little work in hot water tank corrosion, and in no instance was there found a direct parallel to the possibility now presenting itself.

It had been noted, however, by one observer[3] that tubercules from hot water tanks were found to contain bacteria. A program was therefore developed to study the possible effects of bacterial activity on the pitting of hot water tanks.

Plan of Study (First Station)

The first experimental station was designed to try to correlate the rapidity and severity of tank pitting with the growth of high-temperature bacteria, eliminating as far as possible all other factors. Two common and fairly easy methods of inhibiting bacterial growths were chosen: the addition of chlorine, and a considerable increase in pH values through the addition of alkali. It was desired to do this on a scale comparable with normal domestic operation and in tanks typical of those commercially available. The station was located in the La Jolla district of San Diego, where tank failures had been especially severe. (See Table I for analysis of La Jolla water.)

The first station consisted of three standard twenty-gallon gas fired automatic storage water heaters, obtained from regular stock but fitted with special observation taps at the mid-point in each tank. The tank walls were of 12-gauge galvanized steel, and the cold water drop pipes were of galvanized steel tubing. All tanks were isolated electrically by insulating bushings in the pipe connections.

Each tank was made to discharge automatically every hour through the use of an electrically timed series of micro-switches which, through relays, actuated a solenoid valve on the discharge line from each heater, as well as the necessary chemical feeders. An average of five gallons of hot water was discharged from each unit every hour. The temperature was maintained at about 150°F.

The control heater was operated without further treatment with water drawn from the city mains. The chlorinated unit was operated by adding chlorine in the form of sodium hypochlorite solution to the incoming water to provide a concentration of three parts per million of available chlorine. The high-pH unit was operated by adding 65 parts per million of sodium carbonate (Na_2CO_3) to the incoming water, to raise the pH from an average of 7.5 to an average of 9.1.

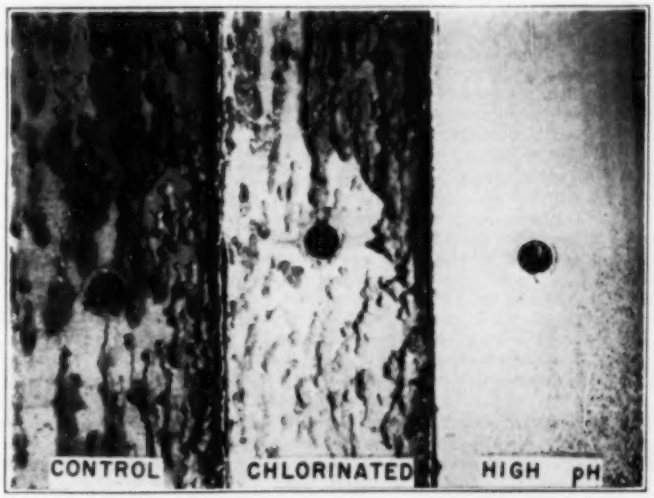


Fig. 1—TANK INTERIORS—after 20 months in service with untreated, chlorinated and pH adjusted water from San Diego's La Jolla Supply.—First Station.

The special observation taps were used to insert both metal and glass slides into the hot water during operation, and to provide a means of inspecting the tanks at intervals without dismantling the piping system.

This station was placed in operation in May, 1946, and ran for twenty months. The control tank failed with four holes through the upper tank wall in January, 1948.

Observations (First Station)

Inspections were made of the tank interiors every six months. At the end of the first six-month period a definite trend had been established, which varied only in degree as the test continued.

The control tank, in six months, had developed a consistent pattern of small tubercles, up to 0.25″ in diameter and spotted every two or three inches over the tank wall, center flue and cold water drop pipe. All metal surfaces were covered with a moderate carbonate coating. Organic odor was very noticeable.

In the chlorinated tank, tubercles were of the same size and appearance, but were spotted four or five inches apart—roughly half as many spots as in the control tank. The cold water drop pipe and center flue had only a few tubercles. All surfaces were covered with a moderate carbonate coating. A mild organic odor was noticeable.

In the high-pH tank, there were no signs of corrosion anywhere. The entire interior was covered with a dense carbonate coating, especially heavy on the center flue. The odor was slight, with no organic character.

Of greatest interest were the findings on glass slides which had been inserted for five days at the operating temperature of 150°F. The slides, carefully sterilized before insertion, were placed and withdrawn aseptically, then stained with gentian violet and observed under the microscope at about 1,000 magnifications. The slide from the control tank was well covered with bacterial colonies. Two distinct types were observed: individual rods, averaging 0.5μ in diameter and 2μ in length, heavy stained; and very small snarled filaments, lightly stained, containing heavily stained spherical granules ranging in diameter from 0.25μ down to the range of vision. The slide from the chlorinated tank contained nothing which could be identified as bacteria. The slide from the high-pH tank contained perhaps one-fourth as many colonies as the control, nearly all of them very small snarled filaments.

Attempts to culture these organisms in the laboratory were only partially successful, either on solid or in liquid media. High-temperature incubation and the question of proper media made the problem greater than our capacity to pursue. No attempt was made to identify the organisms, but they did not appear to be similar to either of the groups usually associated with bacterial corrosion; i.e., the sulphur-reducing and the iron-bearing bacteria.

Upon failure of the control tank at the first station, all three tanks were immediately cut open and examined. (See Fig. 1.) The interiors of both the control tank and the chlorinated tank were found to contain many large tubercles, especially in the upper half. In the lower half, the tubercles were not so numerous, nor were they so large and spongy. The flues and cold water pipes contained large intermittent tubercles in both cases.

The large tubercles all presented the same general appearance—reddish-brown in color, with a width of 0.5″ to 1″, a length of 1″ to 5″, and a height of 0.2″ to 0.75″. In the control tank, several vertical rows of tubercles were almost continuous from top to bottom of the tank. Both tanks were coated with a fine, evenly distributed carbonate scale between tubercles.

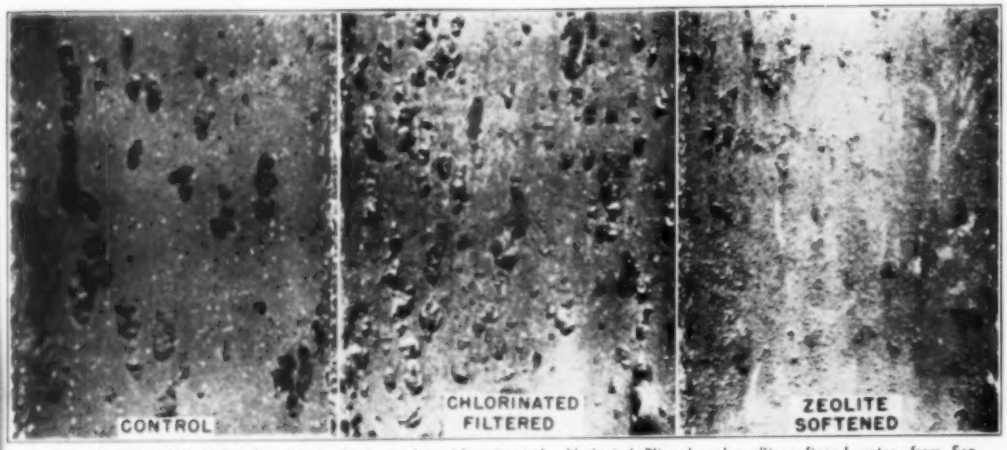


Fig. 2a—TANK INTERIORS—after 40 months in service with untreated, chlorinated filtered and zeolite softened water, from San Diego's El Capitan and San Vincente Supplies.—Second Station.

A representative section of tank wall about one foot square, from each of the tanks, was cleaned and brushed. It was estimated that in both the control tank and the chlorinated tank the galvanizing was gone and the iron had been undergoing attack in about 50% of the area. It was observed that the control tank had undergone the more severe pitting. (See Table II.)

The high-pH tank showed no signs of corrosion anywhere. A thin, hard carbonate scale with many small nodules covered the entire tank wall and cold water drop pipe; a much heavier coating covered the center flue; and about 0.3″ of hardened sludge lay on the bottom. (Note: none of the tanks had been flushed out during the test. This was deliberate, as part of the "abuse" technique.)

Plan of Study (Second Station)

As soon as the La Jolla station began to show some interesting trends, it appeared desirable to launch

a more extensive study to answer some of the questions which had arisen; and to study corrosion factors other than organic activity. The new station was intended to be served with unfiltered, unchlorinated, water from El Capitan reservoir. Untreated water was desired so that the effects of controlled and uncontrolled organic load could be observed, uncomplicated by the normal water purification processes. (See Table I.)

The second station was placed in operation in May, 1947. It included seven standard twenty-gallon automatic storage water heaters, similar to the La Jolla units. The mechanical features of the second station were similar to the first. One unit was provided for the control; one was treated with 30 p.p.m. of lime, to give an ingoing pH of 9.1; one was fed with zeolite-softened water; one was fitted with a magnesium-aluminum (Dowmetal) anode; one was fitted with aluminum anodes and impressed current from a rectifier; and one was intended to receive 2 p.p.m. of glassy phosphate. The latter two units developed mechanical troubles which caused them to be eliminated from the conclusions.

The seventh unit was intended to be fed with sterile water, so that the complete absence of organic activity could be approached. The method finally chosen was chlorination at 5 p.p.m., followed by one-hour storage, then filtration through diatomaceous earth. The diatomite which was used had an effective filtration porosity of about 0.5μ, so that, theoretically at least, most bacteria could be removed. Organic nutrients would, it was hoped, be oxidized by the high chlorine concentration.

The magnesium-aluminum anode consisted of a ¾" rod of Dowmetal 35" long, extruded around a soft steel wire core. The original weight of the anode was 0.9 pound. The total galvanized steel surface of the tank and center flue was estimated to be 14 square feet. When both tank and rod were new, and using El Capitan water, a current of 60 milliamperes was generated. After three months, this had dropped to 25 ma. A very gradual drop in current was then observed throughout the remainder of the test.

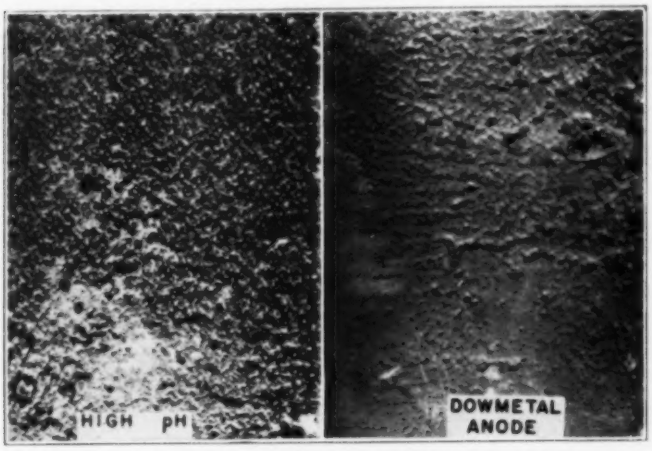


Fig. 2b—TANK INTERIORS—after 40 months in service with pH adjusted water and untreated water, with magnesium-aluminum anode protection, from San Diego's El Capitan and San Vicente Supplies.—Second Station.

After operating this second station for nine months, an unavoidable change occurred in the water supply. The El Capitan supply became exhausted and the new San Vicente (Colorado River) supply had to be substituted. This caused a gradual but eventually complete change in chemical character. The organic quality improved considerably. These changes added variables to the tests which were unfortunate, but which did not affect the overall purpose of the work. (See Table I.)

Observations (Second Station)

The same observation methods were used as in the first station; i.e., periodic inspections of the tank interiors and periodic insertion of glass microscope slides.

Within six months, small tubercles appeared well distributed over the interior of the control tank. The other tanks disclosed no tubercles or a very few small ones at six months. A mild organic odor was noticeable in all of the units except that supplied with zeolite-softened water. The chlorinated-filtered water tank had a mild organic odor, indicating that the frequent mechanical breakdowns in this unit had already defeated the hope of a continually sterile water.

Glass slides were inserted in the control chlorinated-filtered and high-pH tanks for 48 hours. Cultures were made in lactose broth and on glycerine agar and incubated at 140°F; and other slides were stained and examined under the microscope at 1,000 magnifications. No bacteria were found on the stained slides from the chlorinated-filtered tank, the insertions having been made while the treatment facilities were operating as intended. Slides from all other units were usually covered with bacteria. Most of the organisms were gram-negative rods averaging 0.5μ in diameter and from 1 to 2μ in length. A few fine filaments were observed. In general, slide observations from the hot water itself were very similar to those made from the first station.

Lactose broth cultures disclosed no growth from the chlorinated-filtered tank slides, but all of the others disclosed colonies of gram-negative rods which were negative in coliform media. Glycerine agar plates contained similar colonies of gram-negative rods from all heaters, including the chlorinated-filtered unit. As pointed out above, this station was served with unfiltered, unchlorinated water.

Experimental work at the second station was brought to a close in January, 1951, because of the transfer of operating personnel elsewhere. There had been no tank failures at the station in the 40 months of operation. All of the tanks were cut opened and examined as in the first station, with some additional chemical analyses of the bottom sludges.

Tubercles were widespread in the control and the chlorinated-filtered tanks, and to a much less degree in the zeolite softened water tank. The underlying pits, however, were equally deep in all three cases. (See Fig. 2.) There were no signs of corrosion in the anode-protected and high-pH tanks. (See Fig. 3.) Measurements and partial chemical analyses were made of the bottom deposit in all tanks. These are summarized in Table II.

Representative tubercles were picked aseptically from the tanks which were corroded. The tubercles were all of a typical formation; a hard reddish-brown shell, with concentric layers getting darker and

Table I.
CHEMICAL CHARACTER OF SAN DIEGO WATER SUPPLIES

Constituent	First Station	Second Station	
	La Jolla Supply (1946-47 Avg.	El Capitan Supply (start of test)	San Vincente Supply (end of test)
Silica (p.p.m.)	14	17	9
Iron "	0.15	0.05	0.15
Aluminum "	0	0	0
Manganese "	0.25	0	0
Calcium "	47	80	76
Magnesium "	15	11	25
Sodium "	71	36	109
Bicarbonate "	224	158	170
Sulphate "	20	21	264
Chloride "	74	32	81
Dissolved Solids "	334	253	660
Hardness as $CaCO_3$ "	152	115	272
Alkalinity "	162	115	121
Conductivity, mhos x 10^{-6} (@ 25°C.)	89	36	99
pH	7.8	7.5	7.4
Dissolved Oxygen, (p.p.m.) Highly variable (3 to 8 p.p.m.)			
Carbon Dioxide, (p.p.m.) Highly variable (0 to 10 p.p.m.)			

softer toward the interior. The inside, or most newly-formed material, was always black or greenish black, and quite soft.

Aseptic samples of the tubercle centers were plated on slides and stained; other samples were cultured in lactose broth and on glycerine agar, and incubated at 140°F. In most cases, bacteria were observed on the slides. They closely resembled the organisms found on the slides which had been inserted in the hot water during the tests, and also those found in the first station. There was no success in trying to culture the tubercle organisms, whereas the bacteria found free in the water had grown fairly well.

The tank equipped with the magnesium-aluminum anode (Fig. 3) was of special interest, as the use of such anodes for domestic water heaters was then rather new. At the end of the 40-month test, an estimated 0.1 pound of alloy remained on the core wire, exclusive of by-product salts. The side wall of the tank nearest the rod was coated with a loose, flaky deposit to a thickness of 0.5". Elsewhere on the tank wall, the deposit was about 0.05" in thickness. While moist, the deposit was quite soft, except at the interface with the galvanizing. At the interface the material was firm and well bonded to the zinc.

Some Conclusions Reached

The original purpose of the San Diego water heater tests was to investigate the role of organic activity in the pitting of galvanized steel storage tanks supplied from automatic water heaters. Specifically, a study was made to discover if bacterial growths could exist in hot water tanks; and if so, could such growths have a bearing on the pitting of the tank walls. As the tests developed, interesting chemical and other factors presented themselves and were added to the program. These included the effects of zeolite-softened water and of cathodic protection.

Laboratory findings indicated that bacterial growths did exist in the hot water tanks maintained at 150°F., both in the stored water and in the active rust tubercles on the tank walls. Very little success was had in culturing or identifying these organisms, but their presence was consistently demonstrated.

The attempt to produce a water entirely free of bacteria and other organic matter was not wholly successful. There were too many mechanical difficulties in the method used, and frequent breakdowns threw the results of this particular unit into question. The desire to study the pitting in a tank served with sterile water was not realized. Much more elaborate mechanical facilities would probably be necessary in order to produce sterile water in plant quantities without also affecting the chemical character of the water.

The use of water with the pH materially raised did not eliminate all organic activity. It did prove a point already recognized—that corrosion will be stopped if the scale-forming properties of the water are sufficiently increased. In these tests, the pH was raised well beyond the threshold point for scale formation in hot water. Further work would be necessary to arrive at the lowest possible lime dosage to prevent corrosion under such conditions, and thus avoid the excessive formation of sludge such as was observed in these tests.

The effect of zeolite-softened water on pitting was of interest, because of the increasing use of the process in homes. Organically, the softener effluent was excellent and few bacteria were found, although at no time was it completely sterile. Rust tubercles were small and scattered in the softened water tank, but the underlying pits were as deep as those in the control tank.

Value of Cathodic Protection Definite

The most conclusive evidence obtained from these tests was in regard to the use of the magnesium-aluminum anode. Under the conditions of the second station, starting with a water with a conductivity of about 50 x 10^{-6} mhos (at 25°C.), with 0.9 pound of alloy and with 14 square feet of metal surface to protect, excellent results were obtained. The anode was still offering effective protection after 40 months. This anode was not equipped with a resistor as are some of the models now available. The great increase in conductivity of the water, reaching 100 x 10^{-6} mhos half way through the test period, evidently came after the establishment of a resistant scale on the tank wall and on the anode.

The possible effect of bacterial growth on the pitting of hot water tanks has not been fully determined by these tests. In the opinion of the author, such a possibility still exists. More extensive and detailed experimental work would be required to prove or disprove the possibility. At any rate, the question has become a rather theoretical one, because it has been found possible, in San Diego at least, to eliminate pitting with the proper use of magnesium-aluminum anodes. This method seems to offer good protection at reasonable cost and with no serious side-effects, regardless of the many possible causes of hot water tank corrosion.

Table II
ANALYSES OF CUT-OPEN TANKS

Test Unit	Galvanizing Gone	Scale on Tank Wall		Bottom Sludge				
		Thickness	Character	Avg. Depth	Zinc	Iron	Silica; acid-insol.	Calcium; Magnesium salts
FIRST STATION—20 MONTHS								
Control	50%	0.01"	Hard, dense	0.1"	not determined			
Chlorinated	50%	0.01"	Hard, dense	0.2"	not determined			
High pH	0%	0.05"	Hard; heavy on flue	0.4"	not determined			
SECOND STATION—40 MONTHS								
Control	10%	0.01"	Moderately hard; porous	0.1"	3%	40%	15%	8%
Chlorinated-filtered	50%	0.01"	Moderately hard; porous	0.2"	3%	28%	30%	4%
High pH	0%	0.05" (nodules 0.2")	Hard; dense; heavy on flue	1.0"	0	1%	1%	38%
Zeolite-softened	5%	0.01"	Moderately hard; porous	0.1"	3%	15%	36%	3%
Magnesium-Al. anode	0%	0.05"	Soft; porous heavy near rod	0.5"	0	4%	6%	31%

By the time these tests were concluded, the incidence of hot water tank failures in San Diego had been greatly reduced. Many factors were possibly involved, including the change to a totally different water supply, a marked decrease in organic content, better manufacturing methods, and the rapidly growing practice of using magnesium-aluminum anodes in water heater tanks.

Acknowledgments

The author wishes to thank the various concerns which cooperated in this study by loaning or donating equipment, including the San Diego Gas and Electric Co., Day and Night Mfg. Co., Rheem Mfg. Co., Calgon, Inc., and the Dow Chemical Co. Deepest gratitude is due the technical personnel of the San Diego Water Department who spent many extra hours in helping to solve the several operating problems and in preparing and analyzing specimens. These include Howard M. Kull, James H. Keller, D. A. Hoffman, Ruth C. Stewart and others. The project was carried out with the active interest and support of Gerald E. Arnold, Director of the Department.

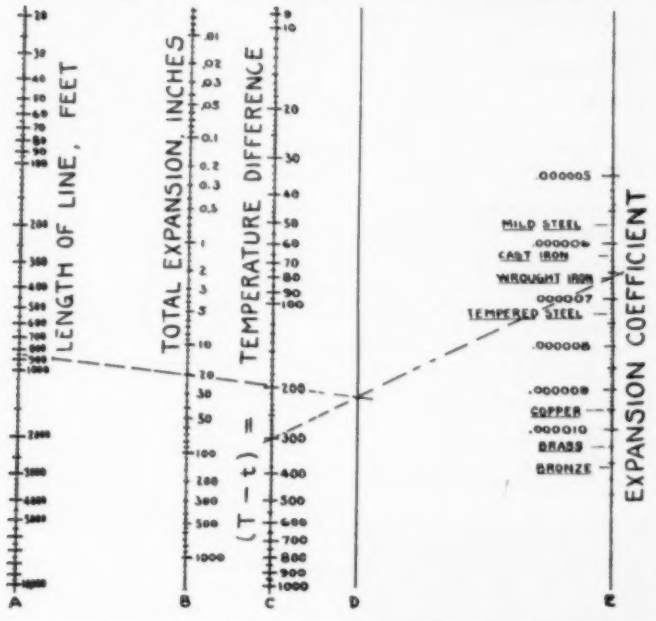
References

(1) Hoover, Charles B. "Failure of Domestic Hot Water Storage Tanks." *Jour., American Water Works Ass'n.*, 38:1005 (September, 1946).

(2) American Gas Association, Project DGR-3-WH. "Galvanic Corrosion of Dissimilar Metals as Applied to Gas Hot Water Storage Heaters"—3 parts. Published by the Case Institute of Technology, 1950.

(3) Wilson, Carl. Personnel communication. 1946.

EXPANSION CHART FOR MOST USED METALS*



This chart will be found useful for quickly determining the expansion of any ordinary metals—from mild steel to bronze—or any material having an expansion coefficient between the limits 0.000005 and 0.000012. The chart handles any length of any of these metals or materials, from 20 ft. to 10,000 ft.

For example: How much will 850 ft. of wrought iron pipe expand when the temperature increase is 300 deg. F.?

Connect the 300, column G, with the coefficient of expansion of wrought iron, column E, and locate the intersection with column D. Then from that point of intersection run over to the 850 in column A and the expansion is found to be 20 inches in column B.

The temperature difference, column C, is found by subtracting the minimum temperature from the maximum. Thus a steam pipe at its coldest may be 40 deg. F. At its hottest it may be 740 deg. F. The difference is therefore 740 — 40 or 700 deg. F.

*Contributed by W. F. Schaphorst, M.E., Newark, N.J.

Liquid Chlorine Bulletin Revised by Solvay

A new and revised edition of "Liquid Chlorine—Its Properties, Transportation Equipment and Safe Handling" has been issued by Solvay. This is the well known Technical and Engineering Bulletin No. 7, expanded to 57 pages by the addition of new data.

Sections of this booklet are devoted specifically to physical and chemical properties, liquid chlorine containers, safe handling recommendations, and equipment and accessories. The concluding section of the booklet is titled "Precautions in Handling Chlorine and Procedure in Accidents." A wall chart, which summarizes the precautions and procedures, is available for posting conspicuously wherever chlorine is used.

Copies of this bulletin will be supplied without charge to readers in the U.S. and Canada. Address requests to Solvay Sales Division, Allied Chemical and Dye Corp., Advertising and Sales Promotion Dept., 40 Rector Street, New York 6, N. Y.

Where Do Our Water Supplies Come From?

Water & Sewage Works so frequently has to answer inquirers who want to know the number of well-water supplies in the United States; the population using well water as against surface water; the ratio of surface water used for public supplies to that from wells; etc.

The following table answers these questions, and since the information appears to have an interest to so many, we are publishing the statistics which have been obtained from various sources.

PUBLIC WATER SUPPLIES
(SURFACE VS. GROUND WATER)

Population (Thousands)	No. of Cities	Ground Water*	No. of Cities	Surface Water*
Over 100	22	3,085,455	144	30,382,555
50 to 100	20	1,481,810	61	4,880,250
25 to 50	67	2,406,860	115	4,594,185
10 to 25	268	3,953,690	284	4,709,565
5 to 10	543	3,581,070	323	2,569,715
1 to 5	3,526	6,995,830	1,193	3,581,315
Totals	4,446	21,504,715	2,120	50,717,585

*Number of people served.

A Rapid Method for the Determination of Fluorides in Water Supplies*

By LAZARUS RUBIN, *Late Chief, Water & Sewage Laboratory, Mass. Dept. of Health, Boston, Mass.*

WHILE the method for the determination of fluoride described in Standard Methods (9th edition—1946) has been found satisfactory, there is need for a more rapid method for use in installation and adjustment of chemical-feed machines for the fluoridation of water supplies. The method devised is a simple modification of the standard method, but has the advantage that the reading is taken at the end of five minutes instead of one hour. In addition, permanent liquid standards have been prepared for this method and so chosen that the color range in the area from 0.8 to 1.4 ppm fluoride is sufficiently wide to enable non-technical personnel to make color readings with greater ease.

Reagents

The fluoride reagent is prepared as follows:

(1) *Zirconium Oxychloride*:—Dissolve 0.43 g. zirconium oxychloride ($ZrOCl_2 \cdot 8H_2O$) in 50 ml distilled water.

(2) *Alizarin Red S*:—Dissolve exactly 0.1 g. alizarin sodium monosulfonate (alizarin red S) in exactly 50 ml distilled water.

(3) Prepare 500 ml of a 1.55 N hydrochloric acid solution (69.8 ml HCl, sp.gr. 1.19) and 1,000 ml of 1.55 N sulfuric acid solution (44.4 ml H_2SO_4, sp.gr. 1.84). After cooling these solutions, mix 480 ml of the hydrochloric acid solution with 520 ml of the sulfuric acid solution.

(4) Pour the 50 ml of alizarin red solution slowly with stirring into the 50 ml of zirconium oxychloride solution. Place exactly 70 ml of the mixed alizarin-zirconium solution in a liter flask and make up to the mark with the mixed-acids solution. This reagent should be allowed to stand 24 to 48 hours in the dark before use. If thus stored, it will be satisfactory for use over a period of two to three months.

Procedure

One hundred ml of sample is poured into a 250-ml glass-stoppered Erlenmeyer flask and 5 ml of the reagent, accurately measured from a volumetric pipette, are added. After shaking, this solution is poured into a tall, 100-ml, Nessler color-comparison tube. Exactly five minutes after the reagent has been added, the color is compared with that of permanent color standards. Where 50-ml Nessler tubes are used, the quantity of reagent is reduced to 2.5 ml. The test may also be carried out directly in the tube if a flask is not available.

Color Standards

Permanent color standards are prepared from two solutions commonly present in a water laboratory, potassium chloroplatinate and cobaltous chloride.

Cobaltous Chloride: Dissolve 12 grams of $CoCl_2 \cdot 6H_2O$ in a small volume of distilled water. Add 100 ml concentrated hydrochloric acid and dilute to one liter with distilled water.

Potassium Chloroplatinate: Dissolve 2 grams K_2PtCl_6 in 300 to 400 ml of distilled water, containing 100 ml of concentrated hydrochloric acid, and dilute to 1 liter with distilled water.

Measure into 100-ml Nessler tubes the volumes of chloroplatinate and cobalt chloride indicated in Table 1 and make up to the mark with distilled water. Mix thoroughly. For use with 50-ml tubes, one-half the respective quantities of platinate and cobalt can be used.

TABLE 1.

Fluorides reading (ppm)	K_2PtCl_6 solution (ml)	$CoCl_2.6H_2O$ solution (ml)
0.0	2.0	24.0
0.6	6.0	15.0
0.8	7.5	12.0
1.0	8.6	9.0
1.2	11.0	5.5
1.4	12.5	2.5

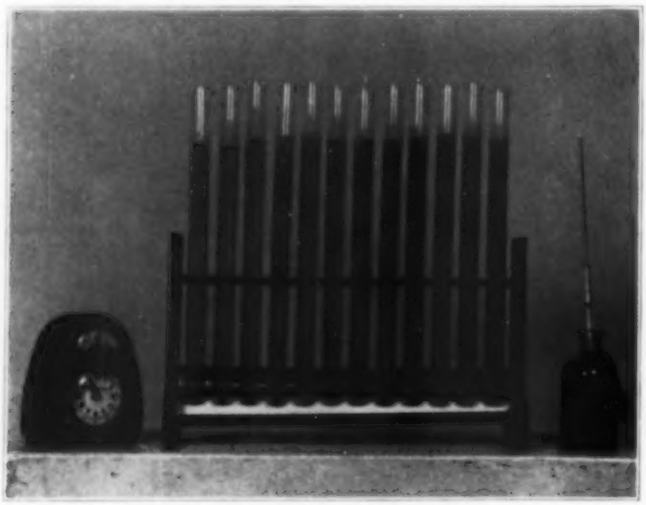
It has been the practice of the laboratory to check each batch of reagent against a known fluoride concentration. We have found that there is some lack of uniformity in the various batches of reagent, the reason for which is not apparent. However, this reagent has been used by both technical and non-technical personnel at an experimental fluoridation installation in Massachusetts since 1946 and has given results that check quite closely with the standard method. It has also been used during installation and adjustment of fluoridation equipment. Results may be expected to be accurate within 0.1 ppm. fluorides.

Interferences

It has been found that, in general, the interferences with the test by the various ions in water are about as indicated for the standard test in Standard Methods, with the following additions:

Free Chlorine. Where a water supply is chlorinated, it must be dechlorinated before the test for fluoride can be carried out. This can be done by adding either 0.5 ml sodium arsenite (0.5 gm per 100 ml), as in the OTA test, or 0.5 ml of 0.025 N

* A method developed in the laboratories of the Mass. Dept. of Health, first published in the Journal of the N.E. Water Wks. Assn., March, 1952.



EQUIPMENT for rapid fluoride determinations

sodium thiosulfate, shaking the sample, and then adding the fluoride reagent.

Temperature. It has been found that, for water temperatures of 45°F. and over, there is little interference with the reaction. For temperatures lower than this the results tend to be low by about 0.05 ppm. fluoride. This can be overcome by warming the water sample to a temperature of 45°F. or above.

N.E.W.W.A. Program Released

For Annual Meeting at Hotel Griswold, Groton, Conn., Sept. 8-10, 1952

Secretary Knox of the New England Water Works Association has issued the following program for the Annual Meeting of the Association at the Hotel Griswold in Groton, Conn., Sept. 8-10, 1952.

A feature of the meeting will be an interesting visit to the submarine base of the U.S. Navy at Groton. The Supt.'s Round Table is devoted to the pros and cons of Fluoridation, the principal topic being a discussion of the question "Which is more practical and economical, fluoridation of water or fluoride enrichment of the communities mil ksupply?"

From Chicago comes John Baylis to tell of "Studies of Corrosion of Cast Iron Pipe," and from London, Chief Engr., Henry F. Cronin of the Metropolitan Water Board to high-light "London's Water Supply."

The Program

MONDAY, SEPT. 8

(Forenoon)

Opening of the Convention and Annual Business Meeting

(Afternoon)

"Progress in Solving Supply and Distribution Problems at Newton, Mass." by Mark F. Croker, Commissioner, Water Department, Newton, Mass.

"The North Fork Water Supply Dam of the City of Asheville, N.C." by Truman H. Safford, Charles T. Main, Inc., Charlotte, N.C.

"Guides for the Selection of Chemical Feeders" by P. A. Coffman, Jr., Chief Engr., Omega Machine Co., Providence, R.I. (Illustrated)

Ladies' Bus Trip to Mystic Museum

(Evening)

Past Presidents' Dinner
Dance Jamboree (Fun, Frolic and Surprises)

TUESDAY, SEPT. 9

(Forenoon)

Superintendents' Round Table
Panel discussion—"Fluoridation of Public Water Supplies."

"The Optimum Vehicle for Fluoridation—Water or Milk?" by Professor Jack E. McKee, Calif. Inst. of Technology, Pasadena, Calif. General discussion by:

Dr. F. E. Law, Regional Dental Consultant, F.S.A., Boston, Mass.
George Wood, Chief Engr., Bd. of Water Commissioners, New Britain, Conn.

(Afternoon)

Trip to the U.S. Submarine Base, Groton, Conn.
Soft Ball Game—Recreation Grounds
Kitchen on Parade

(Evening)

Star-studded Floor Show direct from New York

WEDNESDAY, SEPT. 10

(Forenoon)

"Water Magic", by Fred S. Gibbs, F. S. Gibbs, Inc., Boston, Mass.

"Studies on the Corrosion of Cast Iron Water Pipes" by John R. Baylis, Engineer of Water Purification, Chicago, Ill.

"Pumps and Pumping Stations", by Richard Hazen, Consulting Engr., New York, N.Y.

(Afternoon)

"London's Water Supply", by Henry F. Cronin, Chief Engr., Metropolitan Water Board, London, Eng.

"Application of Ultra-violet Ray Sterilization to Water Treatment", by F. Wellington Gilcreas, Asst. Dir., Chemical Labs., State Dept. of Health, Albany, N.Y.

Entertainment

Ladies' Bridge and Canasta, Card Room.
Aquatic Show, at Pool, featuring Top-flight Diving and Swimming Stars.
Social Hour, on the Lawn Patio. (Compliments of the Water and Sewage Works Mfgrs. Assn.)

Banquet and Dancing

(Compliments of the Water and Sewage Works Mfgrs. Assn.)
Presentation of the Dexter Bracket Memorial Medal and Commemorative Awards.

C. E. Keefer Receives A.S.C.E. Award

The winners of annual awards for technical papers have been announced by the Amer. Soc. of Civil Engineers. These awards are to be presented Sept. 10th in Chicago during the one-hundredth anniversary of the founding of the Society.

Clarence E. Keefer is to receive the Thomas Fitch Rowland Prize for his technical paper titled "Improvements at the Back River Sewage Works, Baltimore." The Board of Directors of the Society awards this prize annually for the best paper describing in detail accomplished works of construction. Mr. Keefer is Deputy Sewerage Engineer, Bureau of Sewers, Baltimore, Md., and is an Editorial Associate of *Water & Sewage Works*.

Orris Bonney is Dead

Mr. Orris Bonney, Chief of the Division of Sewers and Drains, Columbus, Ohio, died July 9th at the age of 56. Born in Grand Rapids, Mich., Mr. Bonney received his C.E. degree from the Univ. of Michigan in 1918 and became an employee of the city of Columbus 27 years ago. He was appointed chief of the division in 1950, and established a record for loyal and effective service.

Be Brief!

Lincoln's Gettysburg Address—266 words.

The Ten Commandments—297 words.

An OPS order establishing the ceiling price for fog-horns, etc—12,296 words.

Author Ullrich

Recording Residual Chlorine in Flocculated Water

Is the "Bottomless" Clarifier a New Idea to You? The Austin, Texas, Water Plant uses One To Solve a Residual Recording Problem

by WM. M. BRENEMAN, J. C. ROLLINGS *and* A. H. ULLRICH*

SOON after the Wallace and Tiernan Co. chlorine residual recorder equipment was introduced in 1948 we became interested in trying this device at the Austin water treatment plant. At that time we were not particularly concerned about recording the residual chlorine in the filtered water but, since prechlorination and preammoniation are employed in the treatment process, we anticipated definite plant control advantages if the equipment could be used to indicate and record the residual in the water leaving the flocculator or mixing chamber. Wallace and Tiernan's local representative, Mr. Harold C. Young, advised us that their recorder operated successfully on clear or filtered water, but had not proved suitable for use with unfiltered water. Since we also practice lime softening and iron sulphate coagulation, our mixed water carries a heavy floc concentration and is, of course, still unstable. Mr. Young felt that these characteristics would make our problem extremely difficult. However, he advised that his firm would loan us a recorder for experimental purposes if we would try to develop a satisfactory method for its use with our unsettled water.

The experimental chlorine residual recorder was installed at our plant in March, 1949, and was operated on filtered or tap water for several months so that plant personnel could become thoroughly familiar with the operation of the unit. Except for minor difficulties at the start, the recorder operated well on the tap water supply.

Test Run With Cuno Filter

A sampling pipe was then installed through the outlet end wall of the flocculator chamber and a small turbine pump was provided to take suction from the sampling pipe and pump the sample water through Saran tubing to the recorder. The Saran tubing was 0.5 in. outside diameter. A motor driven "Cuno" filter, capable of removing particles larger than 0.005 in. diamater was supplied by Wallace and Tiernan Co. and installed just ahead of the recorder cell in order to remove the floc particles. The

Authors Rollings and Breneman
Residual Chlorine Recorder in background

residual recorder was then changed from operation on tap water to operation on flocculator water.

In less than one week after the change, all water connections to the recorder became so "plugged" to necessitate their removal for cleaning. A large quantity of floc was found in the flow controller and in the small detention chamber. The detention chamber was removed from the instrument but floc continued to collect in the flow controller and disrupt the hydraulics of the recorder piping system. Tests indicated that the floc particles were so reduced in size by the sampling pump that they were able to pass through the "Cuno" filter. From this it was concluded that any processing of the sample water should be done ahead of the pump.

Test Run With Glass Wool Filter and Micromet Feeder

The "Cuno" filter was not suited for installation ahead of the sampling pump because it required a positive head for wasting the solids (floc) filtered out of the water. Therefore, our next test was made by using a glass wool filter installed ahead of the sampling pump. This filter was made of a short section of

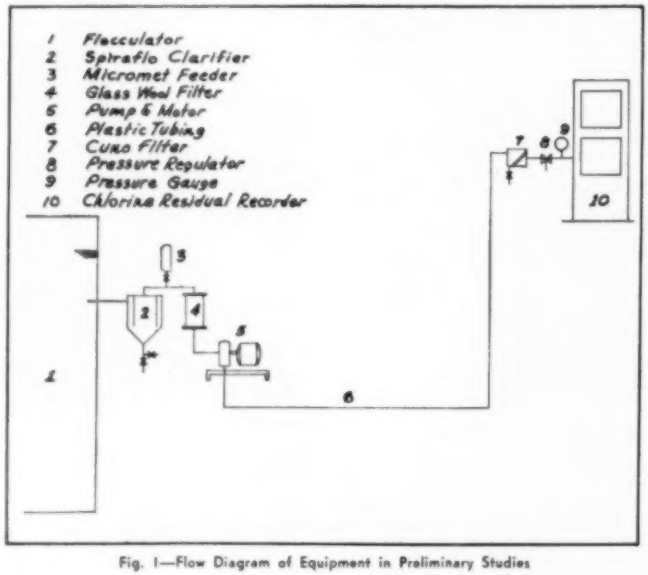


Fig. 1—Flow Diagram of Equipment in Preliminary Studies

*Mr. Breneman is Asst. Supt. of Treatment and Mr. Rollings is Chief Operator and Mechanic at the Water Treatment Plant; Mr. Ullrich is Supt. of Water and Sewage Treatment, Austin, Texas.

six inch pipe having screen wire in the bottom, for supporting the glass wool, and a flanged top.

A micromet feeder was installed ahead of the sampling pump at the time the glass wool filter was installed. During the test run with the "Cuno" filter it had been noticed that, in addition to the physical clogging of the recorder water system, unstable water caused considerable incrustation in the recorder cell and in the small sample lines. The micromet feeder was installed in order to stablize the flocculator water and prevent further incrustation. Prior laboratory tests had shown that, in dosages required for stablization, micromet would have no effect on the chlorine residual.

The micromet treated and glass wool filtered sample water seemed to be of satisfactory quality for the operation of the recorder but the filter became clogged too rapidly for practical continuous operation.

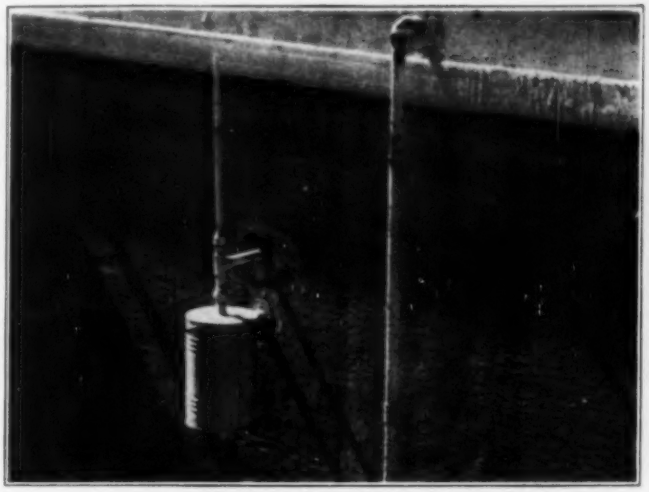


Fig. 2—The "Bottomless" Clarifier
Located at outlet wall of flocculator. Note air vent and sampling pipes.

Test Run With Prior Clarification

In order to lengthen the glass wool filter runs, a totally inclosed, hopper bottom, "Spiraflo" type clarifier providing a thirty minute detention period was installed ahead of the micromet feeder and glass wool filter. The sludge draw-off system of the clarifier consisted of a low rate continual waste and a high rate intermittent surge waste. The clarifier-micromet-glass wool filter combination gave a satisfactory sample water when the clarifier sludge draw-off system functioned properly. However, the low rate continual draw-off system frequently became clogged due to the low flow and low head at which it operated. When the high rate draw-off was operated manually, the entire clarifier was disturbed and the filter became clogged almost immediately.

The glass wool was, therefore, removed from the filter and a test run was made with only the clarifier and micromet feeder in operation. The effluent from the clarifier was found to be satisfactory for use in the recorder without subsequent filtering through glass wool when the sludge draw-off was operating properly. From this it was concluded that a clarifier having a detention period of about 30 min. and processing a well flocculated water, would provide a satisfactory sample water for the recorder *if a dependable sludge withdrawal method could be devised*. Fig. 1 is diagrammatic sketch of the layout used in this test.

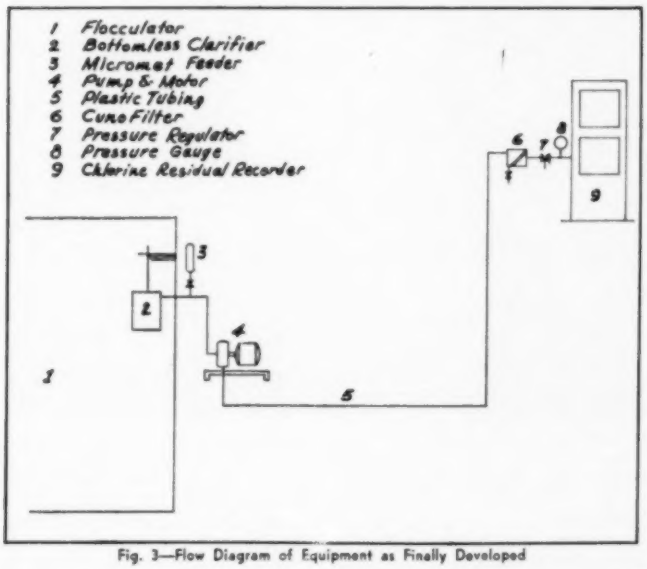


Fig. 3—Flow Diagram of Equipment as Finally Developed

The "Bottomless" Clarifier

Consideration was given to the installation of sludge collcting and automatic sludge draw-off equipment for the small clarifier before the idea of a "Bottomless" clarifier or stilling chamber occurred to us. Our present clarifier consists of an empty H.T.H. can, one hundred pound size. This has a diameter of 15 in. and a depth of 21 in. The can is fastened, with the closed or bottom end up, to the outlet wall of the flocculator chamber. The open end of the can faces the floor of the chamber and the closed end of the can is located about two feet below the level of the water surface. A one half inch air vent pipe extends from the center of the closed end of the can to well above the maximum water level in the flocculator.

The effluent or sampling pipe extends from near the top of the side of the can through the flocculator chamber end wall. A complete view of the bottomless clarifier as installed is shown in the photograph, Fig. 2.

The quality of the effluent from this unit compares favorably with the quality of the effluent which formerly was obtained from the totally enclosed clarifier-glass wool filter combination. The sludge draw-off from the bottom-

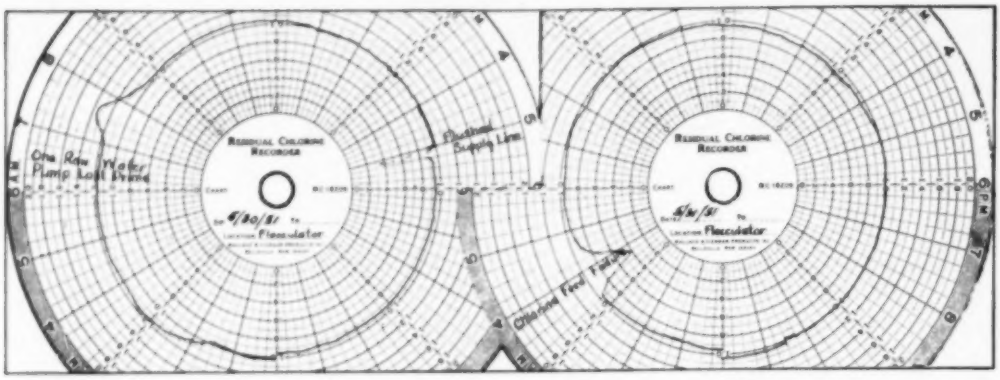


Fig. 4
Chart shows increased chlorine dosage

Fig. 5
Chart shows chlorine feed failure

less clarifier is foolproof because the sludge leaves the unit merely by settling downward.

Fig. 3 is a diagrammatic sketch of the equipment layout which we are now using. Our present sampling device and installation consists of a "bottomless" clarifier (inside the flocculator chamber end wall) and a micromet feeder (outside of the flocculator chamber end wall). A small turbine type sample pump moves the clarified and micromet treated water through plastic tubing to the recorder which is located on the operating floor of the filter building.

Before the water reaches the recorder cell it passes through a "Cuno" filter and the standard pressure control valve furnished with the recorder. As previously noted, the micromet is added in order to stabilize the lime softened water and thus to prevent calcium carbonate incrustation in the sample lines and in the recorder cell. Plastic tubing is used for conducting the sample water to the recorder so that no residual will be lost in transit, as might be the case if metal pipe or tubing were employed. We continue the use of the Cuno filter immediately ahead of the recorder in order to remove any particles which might flake off from plastic tubing or other parts of the system. The pressure control valve, is of course, used to maintain a water sample pressure of 10 psi at the recorder.

Water Velocity is Important

The "bottomless" clarifier has a total capacity of about sixteen gallons and an effective capacity of about fifteen gallons. Calculated on the basis of 0.5 gpm required usage for the recorder, the theoretical detention time is thirty minutes. In actual operation the detention time in the clarifier is less than half of this (or less than fifteen minutes) because some water is continuously wasted at the Cuno filter and some water must be continuously by-passed through the pressure control valve. We have found it helpful to waste sufficient water through the filter and the control valve to maintain a water velocity in the tubing sufficient to prevent settling of particles which may pass through the clarifier and other parts of the sampling device. This velocity in the plastic tubing is in the neighborhood of 1.6 ft. per sec.

With our present method of conditioning the sample water from the flocculator, the recorder has operated with very little more than normal maintenance. About once each month the flow controller, the venturi throat of the aspirator and the hydraulic cell are removed and cleaned. The electrodes never have become so dirty as to cause trouble. Visual observation of flowing grit in the hydraulic cell indicates that it becomes coated with calcium carbonate in about one month. When this occurs, the grit is replaced.

Chlorine Feed Failures Promptly Indicated

At a water treatment rate of 10,000 gpm, our flocculator has a detention time of about 50 min. and the detention time in the plant clarifier is about 2.5 hr. If we add to these detention periods an additional theoretical detention time of 30 min. for the "bottomless" clarifier sampling device, then the theoretical lag between our flash mixer (where chlorine is applied to the raw water) and the residual recorder is about 80 min. This compares with a lag of 3 hr. which would exist if the sampling point were located at the outlet end of our plant clarifier.

In actual operation the residual recorder begins to respond to failures in the chlorine feed much more rapidly. On two occasions the recorder has responded to chlorine feed failures within 40 minutes after the chlorine dosage dropped. In each case the recorder showed a gradual drop in the residual and, by noting this drop, the operator was able to readjust the chlorine feed machine setting so that no drop in the residual was noted in the effluent from the plant clarifier. It is for this reason that we are now completely "sold" on the value of the chlorine residual recorder as an aid to our plant operation.

Figs. 4, 5, 6 and 7 are charts illustrating the reaction of the recorder to changes in plant operation. In Fig. 4 the high residual indicated at 7:30 A.M. was the result of a decrease in the amount of raw water coming into the plant without a corresponding decrease in the chlorine feed. The other irregularity in the curve was the result of removing the recorder from service in order to flush the plastic tubing which conducts the sample water from the flocculator to the recorder. Fig. 5 shows the result of a chlorine feed failure.

Fig. 6 is included as a typical chart showing good plant operation. Fig. 7 shows the result of a failure in the ammonia feed. Whenever the recorder indicates any deviation from the normal, the operator checks the residual of the sample water with a chlorine residual titrator to determine if the fault is with the recorder or with plant operations.

Two-Unit Residual Recording

The Austin treatment plant includes two settling units. In addition to the flocculator-clarifier unit, there is available a separate unit consisting of an around the end baffled mixing chamber followed by a plain settling basin. During peak loads these units are

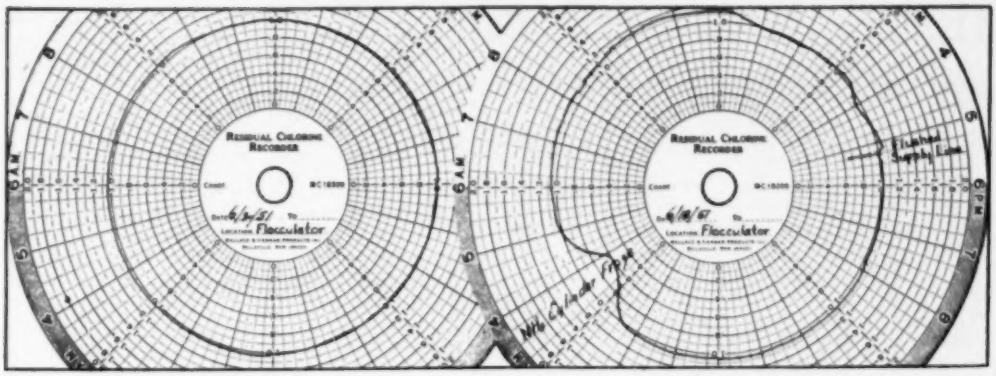


Fig. 6
Chart shows good plant operation

Fig. 7
Chart shows ammonia feed failure

operated in parallel. At the present time we are installing another "bottomless" clarifier-micromet sampling unit in the flume between the mixing chamber and settling basin so that the residual from both treating units may be recorded. A set of automatic timers will be used to operate the two sampling pumps on a fixed cycle. Thus, the newly purchased chlorine residual recorder will record the residual from both units at fixed intervals.

Additional Improvements

A slight change which we have made in the recorder equipment may be of interest to other users of W & T chlorine residual recorders. In the recorder as received from the factory, the buffer solution bottle was located at a lower level than the buffer pump and approximately at the same level as the recorder cell. The small tube pump was required to lift the buffer to the pump level and then force it into the cell. We have moved the buffer solution bottle to a shelf behind the recorder panel at an elevation a little more than a foot above the cell, so that the buffer liquid now maintains a positive head on the tube pump and the pump is required only to proportion the buffer.

The "bottomless" clarifier-micromet sampling device described above has worked so satisfactorily in conditioning the flocculator water supplying the chlorine residual recorder that we now plan to use a similar device for conditioning the sample water for a recently installed three-point recording pH meter. We are hopeful at least that the "bottomless" clarifier will help reduce the maintenance of pH meter cells used in recording the pH of the treated (but not settled) lime softened water. Tests will be conducted to determine if micromet will affect the pH of the sample water, and whether it will be suitable to use for stabilizing the pH meter sample water as we are now using it with the chlorine recorder sample water.

San Francisco's North Point Plant Features Central Control

One of the nation's most modern sewage treatment plants, built to care for an estimated 1960 population of 835,000, has been completed in the heavily developed North Point region of the City of San Francisco.

Shown here is the main control room where special control equipment, supplied by the General Electric Company, permits centralized direction of treatment processes carried on in ten different buildings.

Air Diffusion Manual Published by FS & IWA

Manual of Practice No. 5, of the series issued by the FS & IWA, is titled "Air Diffusion in Sewage Works." This is a practical and useful guide to designers and operators of sewage and industrial waste treatment plants. It outlines the history of air diffusion in this application, and outlines modern practice in design, installation, operation and maintenance of diffusion systems. The bibliography provides 61 references.

The illustrated 75-page manual, prepared by the FS & IWA Committee on Air Diffusion, is available to members at the special rate of $1.00 per copy; non-member price is $1.25 per copy. A discount of 15 per cent is allowed on orders for 12 or more copies. Orders should be addressed to: Federation of Sewage and Industrial Wastes Associations, 325 Illinois Building, Champaign, Illinois.

Utility Inventory Control by Visible Record System

Rapid review of Stock Information and Order Records in California Water Service Co. warehouses

by J. A. GRUNDY, *Mgr., Management Controls Research, Remington Rand, Inc., New York, N.Y.*

THE California Water Service Co., of San Jose, Calif., has twenty-one warehouses in which 14,000 items of stores and maintenance supplies are kept. The problem of central control over such widely dispersed stock is one that is common not only to water and sewage utilities, but also to manufacturers, retail stores and to government agencies.

Using non-visible record systems, even centrally located stock is very difficult to control. Time-consuming counts and recounts must be made, deliveries and disbursements of stock must be traced through a maze of files, and those in charge of supplies are plagued, without any apparent relief, by recurrent overstocks and understocks. This predicament is multiplied in intensity by every additional warehouse, store, plant or branch office.

The water and sewage utility is in a far more sensitive position than most businesses as regards the consequence of inefficient inventory control. The health and safety which depend upon its services can be affected by faults directly traceable to the management of maintenance supplies. Rate structures, depending as they do on the approval of local or state governments, may become inadequate due to the financial drain of poor inventory handling, which is also traceable to the absence of control. The counterpart of this in strictly private industry is obvious: loss instead of profit.

Records vs. Inventory Control

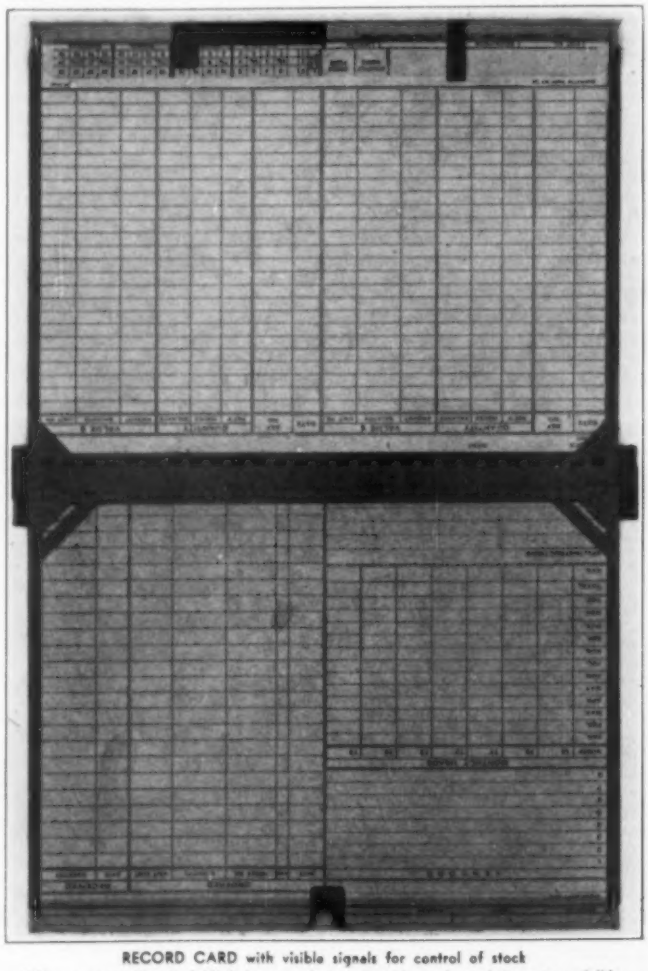
What is the magic by which record-keeping becomes control? How are the raw figures of balances, orders and receipts transmuted into guides, warning signals, and actual advisers to management?

The answer is in the graphic utilization of those raw figures. It is a simple answer, as will be shown in a description of California Water Service's conversion from record-keeping to inventory control. California Water Service Co. adopted Kardex Simplified Inventory Control system, housed in Kardex filing cabinets.

The basic element of this system is a card, or group of cards, containing a complete, consolidated record and control guide for a particular item of stock. Control is provided by Graph-A-Matic signals which range over computing charts on the title insert. This combination of signals and charts is called "The Chart That Thinks." The title insert, carrying the name and catalog number of an item, is a permanent record, housed in a transparent pocket.

Visible Signals the Answer

On the left-hand side of California Water Service's title inserts are calendar strips. A colored signal shows the month in which the item was reordered, if a recent order has been



RECORD CARD with visible signals for control of stock

When top section is folded down, only name and number of item are visible. Colored signals show at a glance (1) when item was reordered and (2) condition of supply.

placed. On the right-hand side of the title insert, a Graph-A-Matic signal is positioned on the chart figure that indicates the balance of an item on hand. Automatically, this signal position shows whether supply is normal, in overstock, or whether a follow-up or an order is necessary. Other useful information carried on the title insert gives the average monthly use of the item, the order point, and the usual replacement time. All of these facts are available at a glance, the signals being carried on the visible margin of the title insert.

Besides the control function of "The Chart That Thinks," there is another striking advantage. With all items and item numbers listed sequentially on visible margins, haphazard search is obviated. With every random element removed, reference is amazingly quick. Also, cards do not have to be handled for posting or reference.

An "In, Out and Balance Record" is also housed in the lower pocket. Here is carried the stock information on which the "Chart That Thinks" operates. After each posting, the Graph-A-Matic signal is positioned to the new balance figure. The chart does the rest.

In the upper pocket is kept the most important record form. Here are listed, in order, the vendors from whom a particular item is bought, a chart of monthly usage of the item, and, on both sides of the easily reversed card, a record of orders and receipts.

Monthly Summary Important

The chart, or summary, of monthly usage is of paramount importance in contributing to the control function of "The Chart That Thinks." On the computing chart, stock balance figures are placed in the categories of "Normal," Overstock," "Follow-up" and "Order" according to experience of the usage of any particular item. Thus, these computing chart figures may, and usually do, vary for each item. On the monthly usage chart, with space for seven years' records, this information is quickly available. The application of this monthly summary to controls and sales records enables management to anticipate seasonal demands and to analyze trends. Stocks are kept in proportion to demand, and savings are realized in the consequent slashing of the cost of possession of overstocks, and the cost of acquisition on rush orders to correct understocks.

OPERATION of Signal-Card Inventory Control System

Entry being made on opened card like that illustrated. Signals on cards lower in the file reveal ease of checking other stock items.

Three-quarters of the form in the upper pocket is taken up with the record of orders and receipts, which provides a running record of orders placed for many years, as well as a record of costs.

Installed in 21 Warehouses

California Water Service's adoption of centralized Kardex Inventory Control over all its twenty-one warehouses has proved to be sound in many ways, not the least of them being the saving of clerical time.

Periodic reviews of stores and maintenance supply position does not require a laborious check of every stock card. "The Chart That Thinks" creates efficient management-by-exception by automatically calling attention to items whose supply conditions require action. By dividing inventory into satisfactory and attention-needing classes, "The Chart That Thinks" makes possible a review of thousands of items in minutes instead of hours.

California Water Service Company's inventory control on 14,000 items in 21 locations handles the distribution of withdrawals with a construction budget of four million dollars requiring a staff of only six people.

This economy of labor is made possible in great part by the physical character of the Kardex Visible system, which has been proved in scientific time tests to be the fastest known method of posting and reference. Because visible record cards are found so quickly, and are not taken from the file and handled for posting, clerks can make more postings per hour with less fatigue.

Thus it is seen how the adoption of a visible record system to provide *control* accomplishes more and effects considerable operating savings as well.

Gerald Arnold to Become Deputy Commr. of Water for Philadelphia

Gerald Arnold, Director of the Water Resources Division—National Production Authority, will leave the federal service about September 10th and assume the position of Deputy Commission of Water of Philadelphia.

He will be succeeded as Director of the Water Resources Division N.P.A. by James Crenshaw who has been Administrative Assistant and who, prior to his service in the Navy during World War II, was a member of the staff of the Water Division, W.P.B.

In Philadelphia, Arnold will serve under the direction of Samuel M. Baxter, Water Commissioner. E. J. Taylor, who has been Acting Chief of Operations of the Water Department is to be transferred to the Engineering Staff of the Philadelphia Department of Public Works.

Those who stand around waiting for "something to turn up" can always start with their sleeves.

How to Solve Odor Problems in Water Chlorination Practice

Practical Discussion of the Nitrogen Trichloride Problem and Simple Rules for Its Control in Water Treatment

by **D. B. WILLIAMS**, *In Charge of Purification, Water Dept., Brantford, Ontario*

DURING the last ten years, many published papers have discussed "break-point" treatment of water, more properly called free residual chlorination. So much has been written that practically all waterworks operators, regardless of their level of technical training, now have a certain fundamental understanding of chlorination applied in this manner.

For example, operators realize that free residual chlorination correctly applied will completely disinfect water in a short contact time. The treatment will disinfect even a highly polluted raw water many times more rapidly than will combined residual chlorination. More often than not, free residual chlorination benefits in the reduction of those tastes and odors caused by industrial wastes, sewages and algae, and also in color removal and improved coagulation.

With regard to taste and odor removal, it would not be correct to state that free residual chlorination is completely effective in all waters, because this is not true. In cases where it is only partially successful, it is quite customary to follow up this treatment by applying activated carbon to remove any remaining tastes and odors. In other instances, it is shown to be more desirable to first apply carbon to remove all taste and odor and then to apply free residual chlorination later for the purpose of disinfecting the water in a short contact time.

Free Residual Chlorination An Accepted Practice

It will be generally agreed that free residual chlorination has been sufficiently widespread in its success to have become well established on the water works scene as one of our accepted methods of taste and odor removal, whether it is used "straight" or whether it requires such supporting procedures as activated carbon, aeration or de-chlorination.

One of the claims made for free residual chlorination is that the chlorine under such conditions has a high "oxidizing potential". This means that the chlorine is in the condition to "burn up" certain substances.

When we use the oxygen of the air to "burn up" garden trash, garbage, etc., we are not the least surprised to find that "smoke and ashes" result. Is it then surprising that a "bonfire" fed by chlorine in water for the purpose of burning up sewage, algae and industrial wastes will also produce smoke and ashes? It is the "smoke and ashes" that has been the cause of so much criticism of free residual chlorination. The "smoke" and "ashes" produced by this process is, in the language of the chemist, NCl_3 or nitrogen trichloride.

Examples of Odor Formation

To carry out the purpose of this paper in discussing NCl_3, why it forms in some waters and not in others, and what to do about it when it does form, will require the use of a number of hypothetical examples, all based on actuality.

Example 1: Free residual chlorination applied to a water containing phenolic compounds and a high bacterial count but free from ammonia or organic substance containing nitrogen.

In this example, we find that the bacteria are effectively controlled and that the phenolic compounds are "burnt up" to a tasteless and odorless form. No "smoke and ashes" in the form of NCl_3 are formed. This is because there are no ammonia or nitrogenous organic compounds present to give up nitrogen to react with chlorine and to produce NCl_3.

The bacteria having been killed and the phenol oxidized, such a water would be ready to leave the plant containing a tasteless, odorless free chlorine residual. In this case we have the perfect example of uncomplicated free residual chlorination—no reactions with substances containing nitrogen and therefore no production of NCl_3 chlorinous odors.

Example 2: In this example all the conditions in Example 1 are duplicated but we add one complication. In this case the raw water contains a substantial amount of free ammonia.

The author has for some time been rather surprised at two attitudes often expressed by operators in regard to this useful process. One attitude is that free residual chlorination is a process in itself requiring only chlorine and nothing else—it either works or it does not. There are and always will be some plants where only chlorine is required for the "break point" process, but they will most likely be outnumbered by those plants where this process requires a supplementary procedure to be successful—such as de-chlorination, ammoniation, carbon application, etc.

The second attitude, closely allied to the first, is to be found in the confusion of workers who have found that tastes and odors, particularly those from algae, have been removed or reduced by free residual chlorination only to be replaced by: "chlorination odors," "chlorine reaction odors," "pungent chlorinous odors," etc., etc.

Some operators finding the practice of free residual chlorination otherwise advantageous have given up its use because of the chlorinous odors produced, when they would have preferred to continue its use and when a little understanding of the principles involved would have solved the difficulties.

Why Chlorinous Odors?

For the purpose of a practical discussion all of these chlorination odors arising from the application of free residual chlorination may be called nitrogen trichloride. This is a gas having an undesirable odor from the water works viewpoint. It develops as a by-product from a reaction taking place between chlorine and certain compounds occurring in the raw water. Its chemical symbol is NCl_3 and, for convenience, we will refer to it in that manner.

The purpose of this paper is to discuss NCl_3 from the standpoint of conditions causing its formation and particularly current methods for its

removal. This paper has not been prepared for the highly trained chemist, but rather has been written as a guide for those in the water works field who profess no detailed knowledge of water treatment chemistry but who, due to circumstances, find themselves involved in the subject of water treatment.

The presence of free ammonia (a constituent of many natural and polluted waters) means that we will be required to use more chlorine in order to produce free residual chlorination than in Example 1. The reason for this is that chlorine burns up ammonia more readily than those other substances that we want it to burn. Therefore, we must apply sufficient chlorine to burn up the ammonia and also to provide additional chlorine in the "free state" to give us rapid bacterial kill and rapid burning of the phenols. If we can conduct our "chlorine fire" with such precision we will have accomplished our purpose and will not have generated any "smoke and ashes" in the form of NCl_3.

A variable ammonia content (which is the same as saying a variable chlorine demand) and a variable pumpage often makes such precise control of water chlorination difficult, in many cases impossible. It is common practice, therefore, to exceed the burning up of ammonia with chlorine to the extent of 1 to 2 ppm free chlorine. This excessive free residual chlorination is often referred to as chlorination "beyond the break point". Such a high degree of free residual chlorination is necessary in many cases; and it is generally favored in practice to eliminate the risk of dropping below the "break", where the formation of the undesirable chlorophenols takes place.

It is when we have free ammonia present in the water and conduct our chlorine fire at too rapid a rate that we obtain NCl_3, "the smoke and ashes." Assuming in this example that we must always chlorinate considerably beyond the break point, for a practical reason such as too short a detention time, and that we are always to experience the generation of NCl_3, just what can we do about it?

It must be realized that once NCl_3 has formed in the water treatment plant and has been permitted to remain in the finished water there is nothing that we can do about it out in the distribution system. All efforts for the elimination of NCl_3 must be applied within the treatment plant and we have several corrective measures to assist us.

If the pH of the water is above 8.5, preferably at a pH of 9, NCl_3 is self eliminating, since it is converted to the more ordinary chloramines and therefore no longer exists as an annoying odor. This conversion is a function of time and pH, and the higher the pH value the shorter the time requirement.

At a pH value above 8.5 the conversion takes place fairly rapidly—certainly well within the detention time of the average plant. At lower pH values such as between pH 8 and 7.2 the conversion is so slow as to render this method of NCl_3 elimination useless. The operator is fortunate if detention time is long enough and pH high enough to convert NCl_3 to the more ordinary chloramines, otherwise he is still faced with the NCl_3 problem. It should be realized that, although the operator is generally not able to increase detention time available, it is certainly within his scope to raise the pH value of the water by means of lime or soda ash.

Odor Elimination

The NCl_3 readily escapes from water, which is the reason why it is so noticeable to the consumer turning on a tap in the distribution system. This property is of help to the operator in those plants where the partially finished water containing NCl_3 must pass through open basins, filters and open reservoirs. With moderate amounts of NCl_3 present a reasonable exposure to open air may be all that is required to dispose of the odor problem in many plants. Of course this method is only partially successful in the case of abnormal amounts of NCl_3 and too short a period of exposure. The author does not encourage too much dependence on such natural exposure, particularly since he has reason to believe that far more NCl_3 can be present in water than has been previously indicated, and further he has observed samples in which NCl_3 has persisted for more than 5 days.

Sunlight greatly assists in NCl_3 elimination, although it cannot be effective on cloudy days, or at night. Both of these natural exposure effects are of no avail in plants where the various basins, reservoirs, etc. are covered.

Aeration by mechanical means, and particularly by means of compressed air, is very effective and has been mentioned quite early by Griffin[1] as a method for NCl_3 removal. Aeration is being used for this purpose at the Hialeah plant at Miami, Fla., where the pH conditions existing in the water during the overall treatment period are particularly favorable to NCl_3 elimination.

Ammoniation treatment alone may often be quite successful in eliminating NCl_3. This is accomplished by applying a slight excess of ammonia to the free chlorine residual existing at the end of the required detention period. What happens is that any "free chlorine" will be converted to a "combined chlorine" residual. Fortunately the slight excess of ammonia will also convert NCl_3 to a chloramine.

FREE RESIDUAL CHLORINATION—THE PROCESS AND ITS CONTROL

The technique of water treatment moved a great step forward with the development of free residual chlorination as a *controlled* process. Application of this process may often be complicated by the production of chlorinous odors, which appear to be principally nitrogen trichloride—a volatile gas. These odors may be so severe as to cause the process to be abandoned.

Don Williams, one of our Canadian contributors, has a long and successful background of experience with the nitrogen trichloride problem. Raw water conditions and plant limitations, at the small (5 mgd) Brantford works, create one of the most difficult of such problems ever reported.

Mr. Williams has endeavored to discuss the formation and removal of nitrogen trichloride in simple, non-technical terms. In this article, he presents plain rules and basic steps which any plant operator can apply. By so doing, the advantages of free residual chlorination may be attained in any water treatment plant—*without* the complications of accompanying chlorinous odors.

The *control* of free residual chlorination and the *problem* of nitrogen trichloride are subjects which have not been adequately discussed in simple terms. The Editors of *Water & Sewage Works* present this "How-to" article in answer to the need for a practical, non-technical discussion.

EXPANSION PROGRAM UNDER WAY AT THE BRANTFORD PLANT

The water purification plant at Brantford, Ont., Canada, currently has a filtering capacity of 5 mgd, and will have a capacity of 7.5 mgd (nominal) or 10 mgd (practical) when its expansion program is completed. Capacity figures are in terms of Imperial rather than U.S. gal. Control of nitrogen trichloride is accomplished largely by means of chlorination, dechlorination, ammoniation, and residual recording equipment.

Current Equipment Includes

2 Chlorinators, 400 lb. cap. each
2 Sulphonators, 400 lb. cap. each
1 Ammoniator, 35 lb. cap.
1 Chlorinator, 50 lb. cap.
1 Residual Recorder (dechlorination control)

By End of 1952 Equipment to Include

2 Chlorinators, 2000 lb. cap. each
2 Sulphonators, 400 lb. cap. each
2 Ammoniators, 50 lb. cap. each
2 Chlorinators, 100 lb. cap. each
1 Residual Recorder (free residual control)
1 Residual Recorder (dechlorination control)
1 Residual Recorder (chloramine control)

Current and new equipment is to be housed in a $50,000 chemical building. There will be facilities for handling all chemicals, and emergency ventilating equipment is to be provided.

Plain ammoniation following free residual chlorination will often be all that is required in NCl_3 elimination. However, under some conditions the results may be unfavorable. For example, in some waters where the pH value is above 7 but below 8, the time required for conversion of NCl_3 to chloramine may be too long and therefore unconverted NCl_3 can pass out into the distribution system along with the chloramine residual. Under such conditions we would find NCl_3 to be very noticeable in the distribution system near the water plant, to gradually diminish in amount as it progresses out into the system, and finally to be absent at the extreme ends. In summary, it can be said that plain ammoniation, unless skillfully applied under optimum conditions, will do only a part job.

When plain ammoniation is used for removal of NCl_3 the method may sometimes give trouble. If the total residual remaining following free residual chlorination is quite high (1.5 to 2.0 ppm), the application of a slight excess of ammonia to convert chlorine to chloramines may result in a combined residual far too high to be desirable from a taste standpoint. The excess ammonia will eliminate NCl_3 as planned but, if the combined residual remaining is too high, an acrid taste may result and therefore we only will exchange an odor problem for a taste problem.

The mere magnitude of a combined (chloramine) residual does not tell the complete story: it is possible to have two identical samples of water both containing a combined residual of equal magnitude and yet find one sample tasteless and the other having a definitely acrid taste. The answer to this may be found in the percentages of monochloramine and dichloramine making up the total combined (chloramine) residual.

From experience it can be stated that the taste of a residual having a high percentage of monochloramine with the dichloramine percentage low or entirely absent will be very difficult to detect. Conversely, the taste of a combined residual which either is entirely dichloramine or is largely so may be very noticeable. In discussing the taste of chloramine residuals, residuals in the order of 0.6 ppm to 1.5 ppm are being considered. The writer prefers to find the dichloramine fraction representing not more than 25 per cent of the total, and preferably less.

Increasing the ratio of ammonia to chlorine will tend to produce a greater percentage of monochloramine as will a high pH value. Conversely, low pH and low ammonia to chlorine ratio are the two conditions which favor dichloramine formation.

Even though the dichloramine taste problem is only secondary to the main theme of this paper, it is still of great importance; therefore, having disposed of NCl_3 the final combined residual should be examined for mono- and dichloramine content by one of two simple procedures * * *.

The acid orthotolidine test and associated procedures of "Standard Methods"* are of no avail in determining relative amounts of monochloramine and dichloramine, hence the importance of the methods given in the preceding references. The procedures cited are simple enough for anyone to perform.

In Example 2 we have seen that the NCl_3 is generated by the reaction between free chlorine above the "break point" and free ammonia only, no other substances being present to contribute to NCl_3 generation. When this condition exists we find that all ammonia will have reacted with the chlorine and all NCl_3 will have formed in the first 20 minutes (a close approximation) following the application of the chlorine. This condition allows the operator ample opportunity to apply free residual chlorination and then, at a later period in the process (prior to filtration), to apply activated carbon for NCl_3 removal.

*Standard Methods for the Examination of Water and Sewage, 9th Ed., Amer. Pub. Hl. Assn., New York

Carbon for Odor Removal

When used in sufficient amounts correctly applied, activated carbon is highly recommended for NCl_3 removal and is used extensively for this purpose. Activated carbon adsorbs NCl_3 in the same manner that it adsorbs other odorous substances. Carbon also adsorbs free chlorine, and at higher free chlorine levels a reaction is said to take place between carbon and chlorine in which some of the carbon is converted to carbon dioxide. It is quite possible that NCl_3 enters into this reaction and that still other reactions may be involved in the application of carbon to a water containing free chlorine and NCl_3. The fact that NCl_3 may be removed from water by activated carbon is the significant principle.

When employing activated carbon for NCl_3 removal certain important points must be taken into consideration. They are:

(1) All reactions between free chlorine and ammonia to produce NCl_3 must be completed prior to the point of application of the carbon.

(2) The completion of reactions between free chlorine and ammonia and the application of carbon must take place prior to filtration.

(3) If carbon is used ahead of filters for taste and odor removal and, when the carbon has been removed, free residual chlorination is applied after filtration, it is quite possible to generate NCl_3. The carbon removed at the filters is of no value in regard to any NCl_3 generated by post-

filter application of free residual chlorination.

(4) While adsorbing NCl_3 at the filters carbon will also adsorb any other tastes and odors present. The remarks pertaining to carbon expressly refer to the finely powdered grade generally used, and it should be realized that where granular activated carbon is employed in pressure filters the same results may be expected.

Value of De-chlorination

De-chlorination by means of sulphur dioxide is an excellent and easily controlled method of NCl_3 elimination. It is the method of choice when the coagulation set up, floc condition, and overloading of filters is such that the required carbon dosage would cause too much carbon to pass through the filters and would result in black water complaints.

Originally, at Brantford, it was thought that complete de-chlorination was necessary to eliminate NCl_3. This conclusion[5] was based on investigations making use of the acid orthotolidine test which cannot sharply define small percentages of a combined residual present with a much larger free chlorine residual. This test and the highly variable pumpage rate gave the false impression that complete de-chlorination was necessary. It was shown, nevertheless, that complete de-chlorination is quite successful in eliminating NCl_3. In view of later findings it is evident that complete de-chlorination may often be wasteful of sulphur dioxide.

We now have had four years of experience in NCl_3 elimination using sulphur dioxide. Employing a Wallace & Tiernan Amperometric Titrator for investigational purposes and a Wallace & Tiernan Chlorine Residual Recorder for de-chlorination control, we can state that the degree of de-chlorination required is dependent entirely on the "free" chlorine residual present.

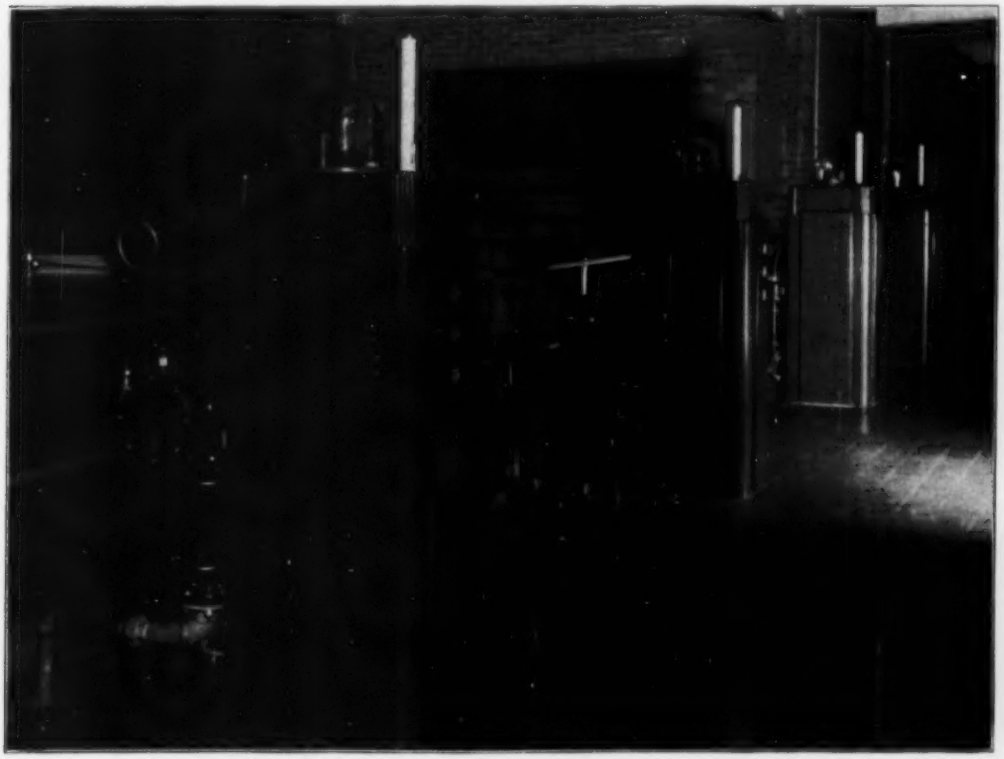
For example, we find that at the end of a given contact period when the water contains a residual of 1.8 ppm free chlorine plus some NCl_3 all that is required is to apply sufficient sulphur dioxide to just use up the 1.8 ppm free chlorine. In this example, ignoring the small trace of yellow color caused by reaction between NCl_3 and orthotolidine, we would be de-chlorinating to a point where the water would be "colorless with orthotolidine."

On the other hand, we may have a water containing NCl_3 in which we find that the free chlorine residual is still 1.8 ppm but that it also contains a combined residual of 0.7 ppm:

Free chlorine	1.80 ppm
Combined chlorine:	
Monochloramine	0.25
Dichloramine	0.45
	2.50 ppm

In this water, it would still be necessary to de-chlorinate only to that point where the 1.8 ppm free chlorine had been removed. When the free chlorine has been removed the NCl_3 ceases to exist, or rather becomes part of the combined residual. In this example, we would have a combined residual free of any NCl_3 in the finished water.

The combined residual existing with the free chlorine residual may not always be as high as 0.7 ppm. In our treated water it has been as low



CHLORINATORS (background) and sulphonators (foreground) at the Brantford plant
These units have seen four years of service in control of tastes and odors

as 0.25 ppm. The relative amount is influenced by contact time, level of free residual chlorination, ammonia content, pH and so on. The important fact, in de-chlorination for NCl_3 removal, is that the more exacting test procedures are required to determine the form in which residual chlorine is present.

Emergency Treatment

If NCl_3 suddenly makes its appearance at your plant and the telephone is ringing with a thousand consumer complaints, the sure fire way of overcoming the NCl_3 problem is to de-chlorinate the water. After de-chlorination, a test should show the faintest possible yellow to orthotolidine. Sulphur dioxide can readily be used as the de-chlorinant.

At the Brantford plant, sulphur dioxide is fed through a sulphonator, which is a Wallace & Tiernan chlorinator having slight differences of calibration. In an emergency a chlorinator can become a sulphonator by merely hooking it up to tanks of sulphur dioxide, and the slight differences in calibration will be negligible for all practical purposes. *Do not* change a chlorinator back and forth from chlorine to sulphur dioxide service. To make the change once in an emergency is excusable, but frequent changing is hard on the machine from the corrosion standpoint.

De-chlorination is the first move in overcoming NCl_3 troubles as a temporary expedient, but since most plants have need to send out a greater residual than "just a faint yellow to orthotolidine," now after the first troubles are ironed out comes the time for greater refinement of treatment.

If, by the recommended test procedures[1, 2, 3], you can show after free chlorine removal that you have a substantial (0.3 to 0.7 ppm) combined chlorine residual to go out into the distribution system, your problem is solved.

If, however, the chlorine residual containing some NCl_3 was practically all free chlorine, and after de-chlorination there was little combined residual left over, you meet another complication. Since the combined residual left over is small, you are tempted to "jack it up a bit" by adding more chlorine after the partial de-chlorination. This is the wrong action to take since the small trace of NCl_3 has really not been destroyed but only converted to an ammonia compound or a chloramine. Further, this conversion product of NCl_3 is present in such small concentration that any later addition of chlorine would readily constitute "break point" treatment, and would regenerate the NCl_3 in substantially the original amount. You would just be conducting another "chlorine fire" giving off more NCl_3 "smoke and ashes."

The answer to this problem is simple. Continue to de-chlorinate to the elimination of all free chlorine—the undesirable NCl_3 then will become either ammonia or chloramine. Follow this step by the addition of ammonia. The added ammonia "protects" the trace of ammonia or chloramine formed from NCl_3 destruction and then later, when chlorine is added to give a residual of practical magnitude, it will combine with the greater total amount of ammonia present to give a chloramine residual containing no NCl_3.

It is suggested that, having adjusted the sulphur dioxide to the desired level of de-chlorination, ammonia then be added and followed by chlorine in the ratio of one part ammonia to three parts chlorine. By trial adjust the ratio and amounts to give a residual of the desired magnitude and one which is predominantly monochloramine. Since it is impossible to make such adjustments using acid orthotolidine, the recommended test procedures are indispensable in this work. For emergency operation, while obtaining required equipment, the orthotolidine test may be used for complete de-chlorination, which then is followed by the ammonia-chlorine additions described.

Example 3:—In this example we have exactly the same conditions as in Example 2 plus one additional complication. The additional complication is the presence of "Organic Nitrogen" in the raw water.

"Organic nitrogen," "amino acids," "organically combined nitrogen," "proteins"—whatever it actually is or whatever you call it—this still is a particularly troublesome source of NCl_3 generation under conditions of free residual chlorination. For convenience, we will refer to all of these organic nitrogen complexes under the general term protein. Reference[4] gives an insight into the source of such proteins, their method of detection and estimation, and methods for at least partially removing them prior to chlorination.

It should be realized that the presence of proteins considerably complicates the NCl_3 problem in water chlorination for the following reasons:

(1) Complete removal of protein from water prior to application of free residual chlorination does not appear to be presently possible.

(2) NCl_3 is formed in a reaction between protein and free chlorine in the same manner as in the case of free ammonia and free chlorine. The quantity of NCl_3 formed is dependent upon the degree of free residual chlorination attained and upon the protein content. From experience it can be stated that NCl_3 generation from protein-chlorine reactions often far exceeds that from ammonia-chlorine reactions.

(3) The reaction between protein and chlorine in forming NCl_3 instead of being completed in 20 minutes to a half-hour, as in the case of ammonia-chlorine reactions, is a relatively slow reaction requiring at least one hour to commence. The reaction may continue for hours and even days as long as there is free chlorine and protein present. This slow reaction can and has resulted in free chlorine residuals and protein continuing to react to form NCl_3 in the water in the distribution system after the water has left the plant. Due to this delayed action it is quite possible to find more NCl_3 some distance out in the distribution system than may be found in the plant.

The Protein Problem

Since we now are able to deal with NCl_3 formed from free ammonia and chlorine what must we do in the case of NCl_3 continuing to form due to protein-chlorine reactions? Our procedures in this example are very similar to those required in Example 2 with the one important exception: after having removed all NCl_3 by any of the several procedures at any point in the treatment process, we must not permit protein and free chlorine to again coexist.

This means that all those actions taken to eliminate NCl_3 in Example 2 (only free ammonia present) may be used in Example 3 (protein present) if we make sure that there is no "free chlorine" remaining. If any free chlorine is present it must immediately be converted to a "combined residual" by means of ammonia.

In the case of aeration, NCl_3 formed from the early reaction between ammonia and chlorine will be removed at the point of application of the air. Also the aeration will remove at that same point any NCl_3 formed by protein-chlorine reactions taking place up to that instant. However, while aeration can remove NCl_3 from any source at any given point of application it cannot prevent further generation of NCl_3 if free chlorine and protein are permitted to co-exist after the aeration has taken place. Reason: after the aeration has removed all NCl_3 present considerably more NCl_3 will be generated later by continuing reactions between free chlorine and protein.

In Example 2 it was necessary only to aerate out the NCl_3 and it was of no import if free chlorine existed or not following aeration. In Example 3 after aeration has done its job free chlorine must not exist and if it does it must either be removed by de-chlorination or converted to a combined residual by application of ammonia.

Regarding activated carbon for NCl_3 removal, the same remarks apply as in the case of aeration. The carbon will remove NCl_3 formed from ammonia-chlorine reactions and any formed up to that time from protein-chlorine reactions. After carbon has done its job in waters containing protein any free chlorine remaining must either be removed or converted to a combined residual.

When eliminating NCl_3 with sulphur dioxide in Example 2, we saw that it was necessary to de-chlorinate to the point where all free chlorine was used up and only a combined residual remained. We also realized that, if the residual remaining was great enough, controlling the de-chlorination to this level was all that was required. We also saw that if the combined residual left over was not great enough we could not just add more chlorine, since this would regenerate the NCl_3, but that it was necessary to first add ammonia and then add chlorine.

When eliminating NCl_3 by sulphur dioxide in Example 3 (protein present) we proceed as in Example 2. We de-chlorinate to the point where all free chlorine is gone. If the combined residual remaining is great enough nothing further need be done. If the combined residual left over is not large enough we cannot just add chlorine since not only will we regenerate NCl_3 but we will create even more by further free chlorine protein reactions. In example 3, therefore, we must first add ammonia and then add chlorine. We must always make sure that the water entering the distribution system contains only a combined residual since it is not possible to maintain a free chlorine residual in a distribution system in a water containing proteins if we wish to be free of complaints due to NCl_3.

This discussion covers the NCl_3 problem from the practical standpoint. The methods of eliminating NCl_3 are all very simple. The choice of method depends on many things—such as the source of the NCl_3, the water pH, detention time in the plant, and availability of such equipment (sulphonators, aeration equipment etc). Supplied with this general description of overcoming the NCl_3 problem and the proper equipment to do so, no waterworks need ever send water containing NCl_3 into a distribution system.

RESIDUAL RECORDER operation explained by the Author
Delegation of nursing students learn of its importance

Useful Footnotes

How to Recognize Nitrogen Trichloride

The author one time described the odor of NCl_3 as similar to that of geraniums. This description is felt to be generally true, although varying concentrations of the gas and varying water temperatures seem to greatly affect the odor. Some observers are reminded of the odor of citrus fruits whereas others find the odor similar to damp hay.

Nitrogen trichloride gas can readily be prepared in sufficient amounts for identification purposes. To do so, dissolve a few crystals of ammonium chloride in 250 ml of distilled water in a 500 ml stoppered flask. Add sufficient chlorine water (from the chlorinator tray) to cause the ammonium chloride-distilled water mixture to give a strong yellow "flash" to orthotolidine reagent. Leave the flask stoppered for 10 minutes, after which shake flask and contents vigorously, quickly remove the stopper and sniff the NCl_3 odor released. Comparing NCl_3 made in this manner with the sample of water suspected to contain NCl_3 in a similar flask will lead to ready identification. Some practice will be required, particularly as to using ammonium chloride and chlorine water sparingly in the first flask. Later as the operator becomes familiar with the odor of NCl_3 at varying temperatures and concentrations it will not be necessary to make a check sample.

How to Save Sulphur Dioxide

In the method for eliminating NCl_3 by de-chlorination employing sulphur dioxide, it was pointed out that the acid orthotolidine test is unable to sharply define a small combined chlorine residual in the presence of a much greater free chlorine residual. Therefore it is necessary for practical purposes when eliminating NCl_3 to de-chlorinate until orthotolidine added is colorless or almost colorless. While an acceptable temporary expedient, for long term use acid orthotolidine is likely to cause unnecessary wastage of sulphur dioxide.

At the Brantford plant, by employing the new technics to show the limits of de-chlorination required and then by controlling de-chlorination in accord with such findings we are now showing a saving of not less than 20 per cent of our previous sulphur di-

oxide usage and often this figure is closer to 35 per cent.

It is expected that the newer analytical procedures will show a considerable range of possible sulphur dioxide savings from plant to plant. At some plants the savings may be negligible and at others may considerably exceed those at Brantford. Sulphur dioxide economy is dependent on the percentage of free chlorine and combined chlorine present at the point of application.

About Residuals

This paper has discussed the elimination of NCl_3 under conditions of free residual chlorination. Since raw water conditions and methods of NCl_3 elimination employed dictate the type of residual permitted to enter the distribution system, such residuals are briefly discussed.

In Example 1 it would be quite permissible to send out a free chlorine residual. In many distribution systems such a free residual would cause no concern. In a "dirty or slimed up" system the sudden maintenance of a free chlorine residual (1.0 ppm or so) would likely cause taste and odor generation in the system. The operator commencing free residual chlorination for the first time would have to make a choice of: (1) let the full force of the free residual take effect on the mains to clear up the system in a few days to weeks—a procedure unpopular with the consumers. (2) Control the magnitude of the free residual (by de-chlorination), start with a small free residual of 0.1 ppm, gradually stepping up 0.2 ppm at a time so that over a period of a year to 18 months the system has been de-slimed without undue annoyance. (3) Convert the free residual entirely to chloramine with ammonia, so that after a two-year period, the chloramine having cleaned up the system, a free chlorine residual could possibly be used.

In Example 2 if all the NCl_3 has been removed either by aeration or activated carbon the operator has the choice of sending out either a free residual or a combined residual. If, however, NCl_3 has been removed by means of plain ammoniation or by de-chlorination with sulphur dioxide followed by ammonia-chlorine additions a final combined residual is the only choice.

In Example 3 regardless of the method of NCl_3 removal the presence of protein leaves us with only one choice, that of a combined residual.

Types of Residual: For brevity the terms "free" chlorine and "combined" chlorine have been used. Free chlorine refers to hypochlorous acid, whereas combined chlorine refers to a chlorine residual in which the chlorine is combined with ammonia. Such a combined residual may be entirely monochloramine, entirely dichloramine or may be a mixture of both.

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"Jinx of Joppa" Routed

Sewage Pump Cloggage Problem Licked With New F-M Bladeless Centrifugals

The Joppa Road Sewage Lift Station of the Baltimore County Metropolitan District has until recently been a real headache for sometime.

The Joppa Road Station, with a capacity of 500,000 gpd, has been the problem child of the system due to the fact that five industrial plants and a large hospital deliver sewage to the station, where it is lifted into the gravity sewer. Rags, bandages, cotton, parts of sheets and other fibrous materials created pump cloggages requiring servicing of the pumps twice daily, although the station was designed to operate as an automatic station.

According to Besley Ambrose, Maintenance Supt. for the Baltimore County District, these twice daily visits to the Joppa Road Station have been reduced to only those required to provide necessary lubrication. The station now operates as a truly automatic station.

The solution to the Jinx of Joppa Road Station was found in the installation on Jan. 12, 1950 of two of the new Fairbanks-Morse 4" bladeless trash and sewage pumps, each direct connected to 15 hp. (1750 rpm) motors.

Supt. Ambrose reports that these pumps have now been operating for 14,000 hours without a single shutdown on account of cloggage. The head-holes on the pumps have never had to be opened. Joppa Station is now truly an automatic station and it is estimated that already the improved bladeless pumps have saved the personnel of the Maintenance Division at least 1,000 service calls and the "Joppa Jinx" is no more.

Geo. W. Welsh, Ass't. Chief Engr. in Chg. of Construction and Maintenance for the Balt. County Metropolitan Distr., was responsible for the selection of the replacement pumps, which were amongst the first of the then new F-M. Bladeless Pumps to be installed in existing plants.

Didya Know?

That one acre of grass can take from the soil and release to the atmosphere as much as six tons (that's right, 12,000 lbs.) of water in a day.

Pollution Problems of Industry -Realism vs. Dogma*

To Resolve Differences, Industry and Sanitary Science Must Find a Common Ground

by **L. L. HEDGEPETH**, *Staff Consultant, American Cyanamid Co., Bound Brook, N.J.*
(Editorial Associate, "Water & Sewage Works")

THE philosophy of industrial stream pollution abatement is a subject which must be approached with some misgivings because of lack of agreement on its principles. Although a completely non-controversial discussion appears impossible without sacrificing candor, certain thoughts have been developed and are offered as constructive criticism of our work.

After reflection upon the successes and the failures recently observed in stream pollution abatement, the author has concluded that the great increase in attention to the industrial waste phase of the stream pollution problem has caused some of our past thinking about stream pollution to become untenable. He believes that critical examination of sanitary engineering thinking on industrial wastes will be helpful, since industry is not accepting the approach of sanitary science without reservations.

Four questions are proposed for discussion here:

I. In which science does stream pollution work belong?

II. What background is required for stream pollution work?

III. Are sacred cows being harbored by sanitary engineers?

IV. What is a workable regulatory philosophy?

I. In which science does stream pollution work belong?

Ample precedent may be cited for the position that stream pollution control work is logically a proper activity for sanitary engineering. For many years scientific work underlying the enforcement of stream pollution law in the United States has largely been a joint function of the stream biologist and the sanitary engineer. This dual attention has resulted from the fact that stream pollution law has been principally directed at the protection of fish life and the prevention of water borne disease. The more recent laws have broadened this base to include other areas of public interest, resulting in active attention to this field by other scientific groups which previously have had little more than a passing interest in stream pollution.

The biological scientists are becoming quite active and one outstanding research unit is now endeavoring to develop biological measurements which will permit "the stream to decide" on the location of a new plant. And, closer to the engineering field, panels on this subject are now appearing regularly on the programs of the AIChE, ASME, TAPPI, ASTM and the ACS. Even the Methods Engineers are looking at our work in order to try to systematize the duties of the operators, thus reducing labor costs.

> ***"Realism is the spirit of current industrial thinking on stream pollution."***

In this rapidly developing situation, little respect is being paid to sanitary engineering concepts which are based upon dogma, however well established they may be. We may protect our sacred cows, but the newcomers will not. Realism is the spirit of current industrial thinking on stream pollution.

In the earlier control of stream pollution, the rights of downstream riparian owners and the protection of the public health were the major underlying factors. This has been broadened today to include other things, such as land use, community and industrial development, recreation and conservation. Of these, public health protection remains the most important. Dedication as a source of public water supply today remains the highest use for a stream. Thus, stream pollution control continues to be primarily a sanitary engineering application. But its broadened base has imposed on us new requirements for a working understanding of other scientific disciplines.

II. What background is required for stream pollution work?

In its simplest definition, sanitary engineering is that technology which applies science and engineering methods to the improvement of man's environment. It is a calling capable of great good for man. It is young—Chase[1] recently fixed its age as 50 years in an address in which he personally recalled many of the men who laid the foundation for our profession. Some consider our work to be a branch of civil engineering, but this is not satisfactorily descriptive, since such a concept does not include all of our area of unusual service, particularly in the stream pollution field. The roots of sanitary engineering are today penetrating for nourishment into many technologies other than engineering; into medicine, toxicology, chemistry, sociology, and the various branches of biology. Phelps[2] humorously summed up this versatility in an anecdote about qualifying for expert testimony in a stream pollution case.

"Are you a biologist?" he was asked, "a chemist?" "a botanist?" "Does your knowledge cover the physiology of fish and the geology of the area?" In his reply he said, "Perhaps I can save time and trouble if I state that my field is Potomology. Its study involves all of these things you have mentioned and many others, in none of which does the potomologist qualify as a specialist save in his own specialty, the science of rivers."

Powers[3], who designed, built and runs our country's largest biological treatment plants for industrial wastes, has this to say about the sanitary engineer in the industrial waste field:

"Our science is young, probably not too clearly defined, and consequently we have a lot to learn. From my observation, I would say that a sanitary engineer in industry is a person who has branched away from some other profession. He probably has had a thorough grounding in engineering, or chemistry, or zoology, or bacteriology, or some other science—

*This paper, presented before the Sanitary Engineering Div. of the Am. Soc. of Civil Engrs. in New Orleans, La., has been released for publication in *Water & Sewage Works*.

"The roots of sanitary engineering are today penetrating for nourishment into many technologies other than engineering."

but his sanitary engineering he has had to pick up for himself."

It has been recently said that religion is an essential part of our background. This may well be true. In our work on stream pollution, we are privileged to closely observe Nature and thereby get occasional glimpses into the great mystery of the order of the Universe. When we read Rachel Carson's[4] recent book about the sea—the order and regularity of its life—and the tantalizing vistas it provides of the unknown, and meditate upon Planck's[5] concept of a devout attitude as being a respectful humility before a supernatural power; we are inclined to include religion in its fundamental sense as one of the several sources from which the sanitary engineer draws energy for stream pollution work.

III. Some sacred cows of sanitary engineering

Sooner or later the industrial waste worker runs against the stubborn fact that sanitary engineering methods and judgment, based largely upon a backlog of experience drawn from sewage and water work, are not entirely suitable when applied to the industrial waste problem. It is difficult to gain acceptance of this point.

For example, we recently engaged in conferences having to do with the determination of chlorine demand of industrial wastes for the purpose of levying charges based in part on the chlorine demand. It was shown that of the three alternative tests for this determination in APHA Standard Methods, one was inapplicable because of color interference, another yielded obviously inaccurate and inconsistent results, and the third was inconsistent and yielded values seven times greater than the second method —specifically, $175,000 annually as compared with $25,000 annually. We suggested that since these testing deficiencies were well known, and accepted, that these tests should be declared unsuitable for use on such wastes.

The reply was that changing the basis of measurement of chlorine demand would limit the usefulness of the data we now have on the bacterial kill obtained by chlorinating sewage. Since only nothing can be gained from nothing, it struck us that this position was untenable; that it would be wiser to amend these tests so that dependable results will be secured in the future.

A similar situation exists on the interpretation of 20°C. BOD values of industrial wastes. This useful device for measuring strength is being prostituted by sanitary engineers for the purpose of setting stream standards and drawing certain statistical conclusions for administrative convenience. These uses are open to attack on two bases:

First, it is patently inaccurate to predict the effect of a waste on a stream flowing along at a different temperature than the standard temperature at which the strength of the waste was determined. Even a grade school biology pupil knows that temperature has a profound effect upon biological activity.

Second, there is no universally applicable yardstick for measuring industrial pollution. This conclusion, reached in 1939 by the Special Advisory Committee on Water Pollution[6] is valid today. There is resentment in industry about the application of the unlovely hybrid, "population equivalent" to industrial wastes. Many industrial people feel that the use of data derived from the standard BOD test should be limited to relative strength statements. Further, that measurements of the effects of wastes on streams should be determined by BOD methods modified to reflect the actual conditions prevailing in that stream.

The condition imposed here, that our newer knowledge be completely intelligible in terms of our older knowledge, may prove to be a detriment.

Another practice which causes industry to look askance at our science is our code of ethics which permits us to use the half truth tactics of politics to gain public approval for some of our objectives. This tampering with the truth probably has grown out of the close association of sanitary engineering with public projects. A case at point is the use of the fear of polio to promote the abatement of industrial stream pollution. Epidemiological evidence does not support the thesis that polio epidemics may be due in part to polluted streams. It is a fact that the mouth is one of the portals of entry of the poliomyelitis virus into the human body. It is a fact that the feces of carriers contain this virus. It is a fact that test animals have contracted polio from experimentally administered *fresh* sewage from polio carriers. But similar experiments were negative with *aged* sewage fom polio carriers. It is also a fact that not one single case of polio has been traced to drinking water as the mode of infection. We have no evidence that polio may be contracted from chemical process waste waters.

We do not disagree with the thesis that stream pollution abatement is in the interest of improvement of public health, and that stream restoration and protection are necessary steps for our civilization—we will fight for pollution abatement with all our energies—but we do seriously question the use of half truths to gain our objectives, as worthy as the objectives may be. Truthfulness, the noblest of all human virtues, is essential in scientific work.

If our profession is to keep pace with the fast developing industrial waste treatment practice, we must be completely realistic and objective in our thinking. This will be difficult so long as we continue to chain our search for newer knowledge in the industrial waste field to the older concepts on which the earlier thinking of sanitary engineers was based.

Planck's[5] comment on the scientist's resistance to change is of interest here:

"This experience gave me an opportunity to learn a fact—a remarkable one, in my opinion. A new scientific truth does not triumph by convincing its opponents and causing them to see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."

IV. Pollution control philosophy

A. For the Individual Industrial Plant

Most sanitary engineers recognize that industrial stream pollution abatement involves a fundamental conflict of economic interests which will require firm measures for resolution in favor of the streams. The competition within any given company for appropriation of available new capital

"Sanitary engineering methods and judgment . . . are not entirely suitable when applied to the industrial waste problem."

is so great that stream pollution abatement projects require a "must" status in order to successfully compete with other demands for available money.

This is a simple but important point in determining regulatory philosophy. Management, within the limits of the author's experience, may be expected to take this view: "We accept stream pollution prevention and abatement as a basic policy. Please give us an estimate of its total cost on this job and its timing in relation to other 'must' requirements now before us."

Obviously, estimates made in response to such requests must be based on proven needs of the stream rather than on dogmatic standards which sanitary engineers have been formulating during the past few years as an easy method of arriving at requirements. If requirements are not real, the money will not be appropriated.

"For, if the requirements are not real, the money will not be appropriated.

B. For Industry in General

Out of the voluminous record of pollution abatement legislation and regulation in the United States, two legislative approaches have developed. These utilize either the "fear of punishment" or the "pride of accomplishment" appeals to human nature. The first seeks to eliminate pollution by fines and other punishments. The second would first outlaw stream pollution, next place it under corrective control, and then secure abatement by team work founded on an absolute requirement for the elimination of pollution.

These approaches are equally effective, and equally ineffective, depending on the problem and the type of individual involved. The Manufacturing Chemists' Association recognized this difference in its 1949 proposal to the Public Health Service that, in the PHS Model Law for States, stream pollution be divided into two classes: "Petty Pollution" and "Pollution".

The MCA thinking is that petty pollution is a police matter for attention at local levels of government, but that the balance requires intelligent technical handling at regulatory levels, as contrasted with police levels. Fines and other "big stick" procedures, now growing in some of our states, have no justifiable place in the control of that industrial pollution which is the result of manufacturing operations.

This is because of the great variations in the industrial waste situation and the hard and unpleasant fact that a measure of stream pollution is an unavoidable result of most wet process industry. Total elimination of industrial pollution is possible only by the utilization of anhydrous processes. Since much of the industry in our country today employs water developed processes, there will be required for some time to come an expendable assimilation balance in the receiving stream below most industrial plants. Our goal should be to keep these necessary discharges of pollutants within the assimilable limits of each of the receiving waters. This appears to be equitable—a higher goal is unnecessarily restrictive—a lesser goal will result in stream degradation.

Our profession, operating above the sordid level of fines and "big stick" procedures, has adhered to the engineering approach. We have developed within our group two schools of thought about how to control stream pollution. These differ essentially on whether to enforce the law by means of standards. The area of disagreement here appears to lie in the timeless conflict between technology and pure science. One is based on the proven practice of the past. It tenaciously clings to a code of performance. The other holds that, since truth is the only safe approach for a scientist, all other considerations are secondary to the facts of each case.

Perhaps intellectual alertness is our real need and is the common ground on which these differences of opinion may be resolved. With it we can grope a little further towards the essence of the industrial stream pollution problem and thus gain further clues to its secrets.

References

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4. Carson, Rachel, "The Sea Around Us," Oxford University Press, New York.

5. Planck, Max, "A Scientific Autobiography," Philosophical Library, New York.

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Shaw Misquoted in A.W.W.A. Report

Harry B. Shaw, Chief Engr. of the Washington Suburban Sanitary Commission, has called to our attention an erroneous statement credited to him in our digest of his remarks before the A.W.W.A. Convention.

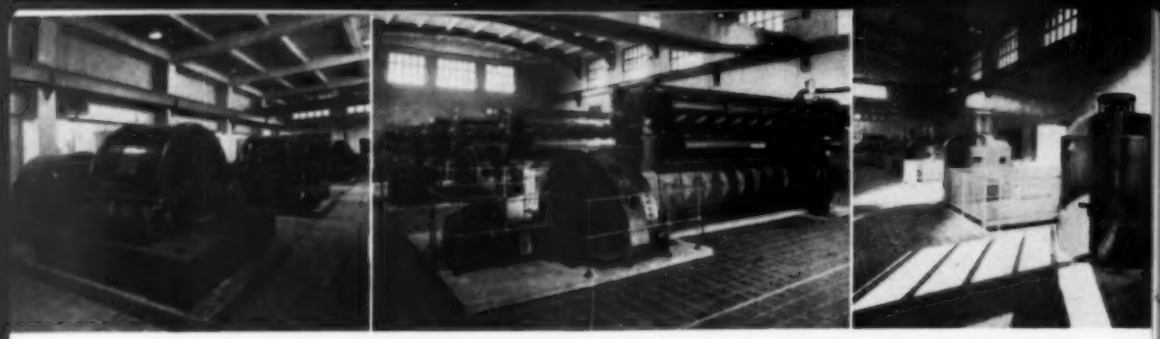
On page 262, of our July issue, the following is credited to Mr. Shaw in reporting his paper dealing with the "Costs of Relocating Water Facilities in Highways," which have been burdensome to water utilities and considered an unjust expense, which does not improve water supply service. The report reads:

"Mr. Shaw advocated the establishment of special committees in each A.W.W.A. Section to work through their congressman for support of the Keller Bill. The same attack should be planned at the state level to take care of situations wherein Federal funds would not be available."

The first error is that the bill before the Congress, which will authorize Federal Highway authorities to stand all or any other equitable part of the cost of relocating utility facilities created by highway relocation, widening, or regrading, was referred to as the Keller Bill. It is the McKellar Bill (S-2585).

The second error is in crediting Mr. Shaw as having advocated the establishment of special committees in each section of A.W.W.A. to support the McKellar Bill. Mr. Shaw explains that he advocated the establishment of special committees "to support new and appropriate legislation"; but, not necessarily to support the McKellar Bill as the only or best solution. As a matter of fact Mr. Shaw does not believe that the entire cost should be borne by any single interest, but that each should bear its proportionate and equitable share of the expense. This, of course, is in essence what the McKellar Bill calls for; namely **all or any part of** the relocation costs to utilities.

[Ed. Note: The remark credited to Mr. Shaw might be interpreted to indicate that he feels that the Federal Highway Agency should reimburse the water utility for the entire expense. Therefore, we are happy to run this correction. Further, we urge any speaker, who at anytime finds himself incorrectly credited with some statement or credited with a statement subject to misinterpretation, to call the matter to our attention. A correction will be run promptly.]



OWL'S HEAD—New York's Newest and Most Modern Treatment Plant

Silver Anniversary Program of Sewage & Ind. Wastes Federation

Annual Meeting in New York City October 6 to 9 Promises To Be a High Point in Federation's History

THE SECRETARY'S OFFICE of the Federation of Sewage and Industrial Wastes Assoc., has released the General Program for the Silver Anniversary annual meeting of the Federation in New York City, October 6-9, 1952.

Aside from the technical information and helpful advice in regards operating problems, obtainable at the Federation's annual meetings, the lighter side of such national gatherings is not overlooked. The Local Committee on Arrangements, under "Doc" Symon's energetic chairmanship, has arranged for a nice lot of social events, sight-seeing and "Doing the Town" in the way of theater-going and night-spot hopping by those so inclined. Also, special events for the ladies sound particularly inviting, including a view of the United Nations in action.

The closing feature will consist of an inspection trip to one of New York City's newest and finest sewage treatment plants—The Owl's Head Plant. Here one will see everything that is modern in sewage treatment and New York City's own process of economical "Modified Activative Sludge" at work. It's new; it's economical; it works; it's worth knowing about!

The Technical Program

SUNDAY, OCTOBER 5

(Afternoon)

Early registration and inspection of exhibits

MONDAY, OCTOBER 6

(Morning)

Reports of FSIWA Officers

Sewage Disposal Problems of the World's Largest City
RICHARD H. GOULD

(Afternoon)

Detergent Compounds, Their Composition and Behavior
LAWRENCE FLETT and L. H. HOYT
Discussion to be arranged

Operating Experiences with Detergents at Washington, D.C.
RALPH E. FUHRMAN
Discussion by Samuel A. Greeley

The Action of Detergents in Sewage Treatment—A Study by Industry
W. R. GOUDY
Discussion to be arranged

Effect of Detergents on Sewage Microorganisms
RAYMOND MANGANELLI and EDWIN S. CROSBY
Discussion by W. L. Mallman

(Evening)

Family Night Entertainment

TUESDAY, OCTOBER 7

(Morning)

Sewage Works Management
HENRY J. GRAESER
Discussion by Van P. Enloe

Rehabilitation of the Schenectady Sewage Treatment Plant
EDWARD S. ORDWAY
Discussion to be arranged

Electric Power System Practices for Sewage Plants
M. C. BOGGIS
Discussion by Richard R. Kennedy

(Noon)

Silver Anniversary Luncheon
The Federation from 1927 to 1952
CHARLES A. EMERSON

The Federation and the Future
ABEL WOLMAN

(Afternoon)

Operating and Economic Factors in the Packinghouse Waste Problem
H. O. HALVORSON
Discussion by M. D. Sanders

Treatment and Disposal of Milk Wastes
SAMUEL I. ZACK
Discussion to be arranged

Other Recent N. Y. C. Plants—26th Ward; Hunts Point; Rockaway

Waste Recovery and Treatment in Viscose, Rayon and Film Manufacture
H. L. JACOBS
Discussion by Charles E. Renn

Chemical Wastes Disposal by Pratt and Whitney Aircraft
ALLEN J. BURDOIN
Discussion by Guy E. Griffin

WEDNESDAY, OCTOBER 8

(Morning)

Biological Factors in Stream Sanitation
RUTH PATRICK
Discussion by A. R. Gaufin

Simplified Determination of B.O.D. Curve Characteristics
HAROLD E. ORFORD and W. T. INGRAM
Discussion by Harold A. Thomas

Bactericidal Efficiency of Sewage Chlorination
SETH G. HESS, ALEX N. DIACHISIN and PAUL DE FALCO, JR.
Discussion by W. W. Sanderson

Photosynthetic Oxygenation in Sewage Treatment
W. T. OSWALD, H. B. GOTAAS and H. F. LUDWIG

(Afternoon)

Industrial Wastes Forum
R. W. HESS, Leader

Flotation
Skimming
Subsurface Disposal
Lagooning with Sodium Nitrate
Anaerobic Digestion
High-Rate Filters

(Evening)

Silver Anniversary Dinner Dance

THURSDAY, OCTOBER 9

(Morning)

Sewage Plant Operators' Forum
J. HENRY GILES, Leader
How to solve your problems of:

Personnel: recruitment, training, salaries, etc.
Pumps: maintenance, capacity, replacement, etc.
Sludge Digestion: starting, heating, cleaning, overloading, etc.
Sludge Disposal: recovery, composting, sale, etc.
Aerobic Treatment: Trickling filters, activated sludge, aeration, etc.
Laboratory: layout, equipment, application of test data, etc.

Come prepared with your questions for discussion. The success of the Forum will be governed by your interest and participation!

(Afternoon)

Inspection of New York's Owls Head Sewage Treatment Plant

To Chlorinate or Not To—That is the Question

The press reports that Stevens Point, Wis., which long has called itself the "city of wonderful water," will have to decide soon whether it will permanently chlorinate its water on a continuous basis.

Residents aren't happy about the situation. They don't want to see any foreign substance put in the water. The supply comes from an underground system of wells and for years has been pumped directly into the city water mains. Residents have been proud of their "pure water."

The state board of health, however, has taken a different point of view. It has urged permanent, continuous addition of chlorine as a safety measure. The board, while it has the authority, has never gotten quite to the point of ordering such a measure.

Since April, the Stevens Point board of water and sewage commissioners has been putting in chlorine continuously on a test basis. Chlorination started after laboratory tests disclosed contamination of the wells.

It was generally thought that temporary high water in the ground was responsible for the contamination and that it would clear up in time. So the chlorination was scheduled to last until sometime in July.

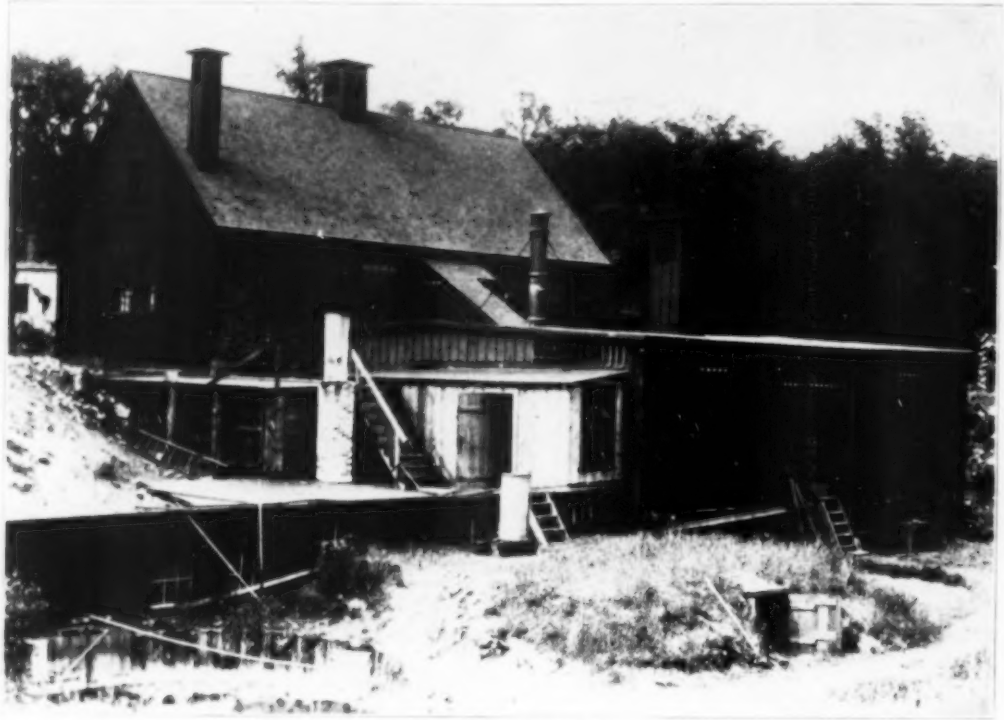
Frequent tests, however, have shown that the contamination has not cleared up. The feeling seems to be that if contamination remains, so will chlorine. Otherwise, the chlorine addition will be stopped.

Most persons have accepted the chlorination as a necessary "evil" but a few have objected vigorously to it. They are the same ones who led a referendum battle in September, 1950, that resulted in the stopping of fluoridation of the water. The fluoridation had gone on for about five months.

"HOLLAND TUNNEL, NOTHIN'! LADY, YOU'RE IN THE PLOOPVILLE STORM SEWER!"

Supply Water to Industry Outside City, Says PSC

Milwaukee has been ordered by the state public service commission at Madison to supply water to the part of the General Motors Corp. plant that lies in the city of Glendale. The rest of the plant, at 4066 N. Port Washington Rd., is in Milwaukee. The PSC said service could be made by connecting two feet of pipe to an active main. It would cost General Motors "upward of $45,000" to develop its own supply, the PSC said.



Lawrence Experiment Station in 1903

Rear view of laboratory building and shed housing filter units. Sand filters in foreground. The mound, lower right, is first covered intermittent sand filter constructed in 1890.

Original Buildings during the flood of 1901

This is the building shown at rear of laboratory in photo above.

History-Making Lawrence Experiment Station

A Unique Contribution to Sanitary Science Founded Sixty-Six Years Ago by the Massachusetts Department of Public Health

by JOSEPH A. McCARTHY, *Chief of Laboratory, Lawrence Experiment Station, Lawrence, Mass.*

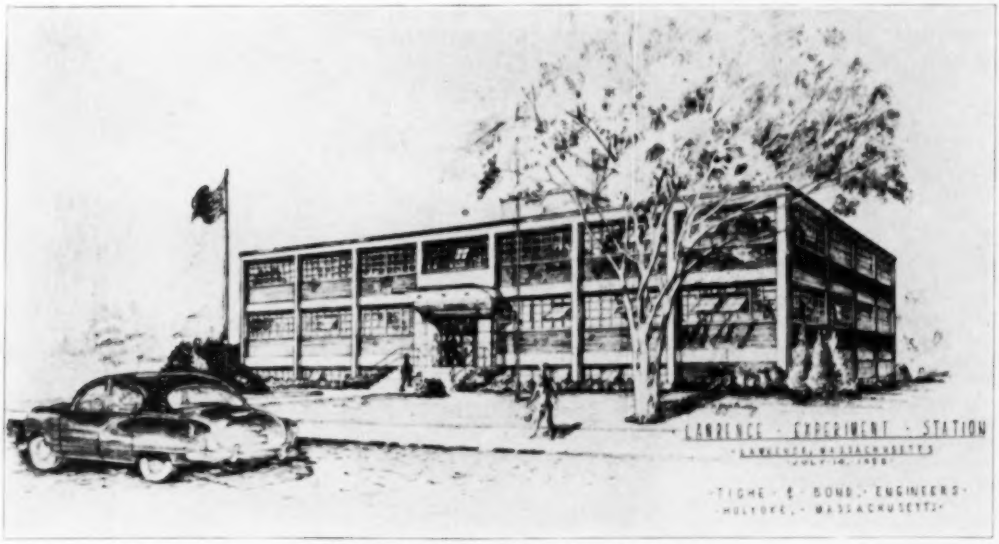
LEMUEL SHATTUCK, in his famous report of the Sanitary Commission of Massachusetts[1] in 1850, strongly recommended that a civil engineer should be one of the members of the General Board of Health. In 1886 the State Board of Health, first organized in 1869, was reorganized and Hiram F. Mills was chosen as the engineer member of the Board. As Chief Engineer of the Essex Company, builder and proprietor of the dam and canals in Lawrence, he had for some time been engaged in investigations of the hydraulics of the flow of water in small pipes.

Immediately after his appointment to the State Board, Mills suggested a study of the filtration of sewage through soil, and offered the Board of Health the use of the area on which his hydraulic experiments had been conducted. The facilities available were bare indeed; alongside the Merrimack River there was

The Author

located a trench which had been used in the hydraulic studies, and a primitive type of shed was available. The land adjacent to the trench was fine river silt and in this area long grooved furrows were dug to study the percolation of sewage. At the same time 10 circular wooden tanks were built, each about 17 ft. 6 in. in diameter. These tanks, set flush with the surface of the soil, were filled with various depths of fine and coarse sand, gravel, peat, and other materials available in New England. The tanks had been so constructed that the effluents could be collected in appropriate compartments in the long trench and sampled for examination. Very soon thereafter several smaller tanks were constructed to permit additional investigations.

Previous to this time, it appeared to be generally known that when sewage was distributed on soils of various types a considerable change in the character of the liquid could be effected. While Mr. Mills never claimed credit for the origination of the theory of biological purification of sewage, he unquestionably recognized that mere mechanical straining was not the only action or the most important action. It seems clear, from statements he made in the 1890 report, he took it as an accepted fact that bacterial life was essential for the purifying of sewage. He spoke of astonishing results abroad,



The Lawrence Experiment Station planned for 1953
As it will appear in its new location on Shattuck Street

Front of the Laboratory building in 1903

The bacteriological and chemical laboratories of the station are in this building (hitching posts at the front door)

Dike constructed at rear of Station after 1901 flood

A flood in 1936 inundated all this area and the laboratory, rising to a level just below the laboratory benches

but he goes on to say, "Until the Lawrence work began very little was definitely known anywhere of the conditions most favorable for the purification of sewage by any given material.'" He said later in this same report, "The Experiment Station at Lawrence has been arranged and the experiments have been conducted for the purpose of determining the fundamental principles of filtration *not previously established* and to learn what can practically be accomplished by filters made of some of the widely varying materials found in suitable locations for filtration areas, etc."

Station Personnel

Mr. Mills was a stately man, faultlessly dressed, fair to himself and all others but demanding the fullest possible measure of work. Aside from his great vision, his major contribution to sanitary science was his ability to gather together and direct an extraordinary group of men, most of whom were young recent graduates of the Massachusetts Institute of Technology where they had studied under engineers, chemists and biologists who had previously done consultant work for the State Board of Health. They were therefore well acquainted with the ideas of the time and the best available information regarding the measurement of the effects of treatment.

Among the men serving in these very early years were Thomas M. Drown, who might be considered the second sanitary chemist in the history of America; William T. Sedgwick, biologist, who, with Professor Drown, developed and adapted the first methods of analysis; George W. Fuller, chemist; Gary N. Caulkins, biologist, later at Columbia; Edwin O. Jordan, bacteriologist, later at the University of Chicago; Allan Hazen, who became one of the outstanding experts in sanitary science; and Harry W. Clark, who a few years later became Director of the Station. Under the leadership of Mr. Mills, to quote from Gordon M. Fair, "Thereby was initiated a decade of sanitary investigation, the like of which has never been seen again."

Organization

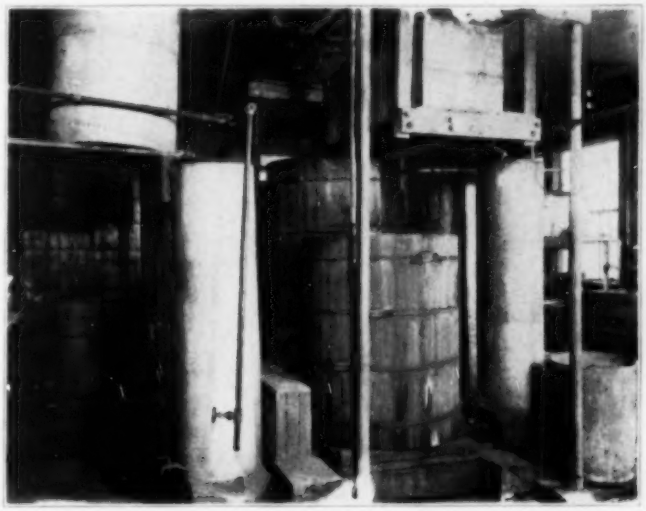
In the earliest days apparently little attention was paid to definite organization. Mr. Mills selected the men in the beginning and added others as they became available, but apparently titles were very little thought of. It appears from the names signed to the early reports that first George W. Fuller and, a year or two later, Allan Hazen, signed the reports made to the State Board of Health—presumably they could be considered as having been in charge of the Station at that time. In 1895 Harry W. Clark was officially named Chief Chemist, and shortly thereafter he was also put in charge of the Water Laboratory in Boston; he held these two positions, with occasional changes in

Interior of first building—about 1896

Galvanized tanks were used in early studies—those in foreground are units containing coal and coke media

title, until his retirement in 1933. In that year the Laboratory Service was merged with the Sanitary Engineering Division and George O. Adams was made Chief of Laboratory. Upon the death of Mr. Adams in 1941, Joseph A. McCarthy was placed in charge of the Station and has continued in that position to date. Thus it may be said for all practical purposes, for about 60 years of its life the Experiment Station has had only three directors.

This long service has been characteristic of many of the other employees of the Station. Stephen DeM. Gage, as biologist, spent 20 years at the Station. Mr. Adams had a total service of 41 years. Joseph A. McCarthy is now in his 42nd year at Lawrence. Patrick Keegan began working as a laborer in 1888 and retired as filter operator in 1929. His son, Henry Keegan, succeeded him and is still in service at the Station. William J. Magee, now in charge of the Boston Water Laboratory, spent 37 years at the Station; and many other employees, present and past, have served long years. A great many of the employees have moved on to service with other states and cities—at the present time almost 40 graduates of the Experiment Station are engaged in sanitary work.



Filter House interior in 1905

Tanks of wood as well as metal set up for more elaborate experiments in sewage treatment

Early Ideas of Treatment

The early investigations by Mr. Mills and his group of assistants seemed to concern themselves with three broad ideas: one, that although the very finest materials might produce filters of equal quality, such materials had no place in the solution of practical problems; the second, that sewage alone, even after sedimentation of the coarser particles, still contained enough organic matter to provide complete nutrition for the bacterial life which he knew was necessary; the third, that copious quantities of fresh air must be drawn into a filter in order that the proper organisms might carry out their function.

The newly developed types of analyses, especially those of the various forms of nitrogen led Mr. Mills and his assistants to the belief that final purification of sewage could be demonstrated only by the presence of a large amount of nitrates in the effluent. It is interesting to note that many methods which they used *as preliminary treatments* before final filtration, including chemical coagulation, aeration, sedimentation, the addition of metallic salts, and adjustments of acidity and alkalinity, today represent what is regarded as a sufficient degree of treatment in many locations. It is probable that some of the methods we now consider modern were quite adequately studied in the 90's and were dismissed because they did not represent purification reaching the standards of high nitrification and practically complete stability.

It was very early recognized that some satisfactory measurement of filter media must be available if experimental results were to be translated into practice. Allan Hazen, in 1892, conducted thousands of experiments and measurements; and he proposed the theorem that the effective size (measurement of the 10 per cent of the finest sand in a given medium) and the uniformity coefficient of the sand (a measurement of the distribution of sizes) provided very acute measurements, especially when related to his temperature studies of the future performance of such sands as used in filtration.

Sedimentation studies resulted in establishing principles still valid today. They gave the early workers means for obtaining a partially clarified sewage free of practically all organic matter, which they believed to be amply prepared for filtration. Once the sedimentation practice had been established, they were able to show that a sand filter should not necessarily be clogged but, with properly prepared sewage, judicious rates of application, and careful cleaning of the surface, might be operated continuously. One such unit started by them in 1890 actually operated for 46 years—receiving daily doses of sewage without any necessity for removal of sand.

After the principles of filtration had been established, it was an easy step to develop into trickling filters and these were first operated about 1890. The insistence that effluents from these filters should approach those from sand filters in quality influenced the work of the Massachusetts State Board of Health for a long while, although there was clear evidence that the equivalent of the high rate trickling filters were operated very early in the work at Lawrence. Another field of investigation was that of septic tanks; as early as 1895 workers at the Station pointed out the value of such units in reduction of solids, and likewise pointed out that the effluents from septic tanks must be considered as still containing all the potentialities of danger found in completely untreated sewage.

Bacteriology Develops

At the beginning of bacteriological and biological studies, they were confined almost entirely to direct connection with the experimental work—first on the sewage filters, and then on the water investigations which followed later. Within a very few years, however, the bacterial examination of water supplies and of streams was undertaken and, at least as early as 1895, the systematic bac-

View of Chemical Laboratory in 1904
Chemical analyses of water and sewage samples conducted here

terial examination of municipal water supplies became a function of the Station. The early work consisted mainly of plate counts and microscopic examinations. In 1896 "B. Coli" examination was an integral part of all bacterial work, and by 1900 the use of the coliform group as an indicator of quality for bacterial water supplies had apparently been accepted.

The bacterial examination of water from public supplies, as well as camping areas, school supplies and almost any other water that bears a relation to public health has been conducted throughout the life of the Station. At the present time, about 20,000 bacterial examinations are made at Lawrence each year. Some 7000 of the samples are collected by representatives of water systems and sent to the Station by mail, so that every water supply in the state, large or small, receives an appropriate number of examinations at least every four weeks. In addition, the Station serves as a storage place for emergency chlorination apparatus and other means for improving the quality of water. This equipment is capable of providing emergency treatment for at least 12 million gallons per day, and may be quickly moved to any part of the Commonwealth.

Bacteriological research has been continuous at Lawrence, particularly as concerned with water quality, disinfectants, storage, and adequate means of demonstrating the quality of water. The Station has been closely connected with the United States Public Health Service and several of the Station personnel have been on committees of the A.P.H.A. and other similar organizations in the establishment of standards. At the present time the Station is one of the few laboratories making extensive investigation of bacterial examination by means of the membrane filter technique.

Industrial Waste Treatment

Almost from the beginning of experimental work, the effect of industrial wastes on sewage has been recognized; and investigations have been carried on to treat such wastes either alone or in conjunction with domestic sewage. A long series of sand and trickling filters have been operated, receiving various mixtures of domestic sewage and wastes from milk plants, from carpet mills, from gas works, from tanneries, from breweries and from all the various textile processes. As early as 1896, chemical coagulation of wool waste was used with some success. It is interesting to note that in 1947 an effective method of treating such wastes by means of calcium chloride was introduced by the work at the Station.

The work from the earliest days to the present has been greatly concerned with counteracting or reducing the bactericidal effect of the ingredients of industrial wastes. The Station has always been closely connected with studies of these toxic materials and has been represented in practically all the work of the F.S.I.W.A. on this subject. At present, study of industrial waste problems makes up over half of the work of the chemical and research laboratories.

Water Treatment

It was an easy step from filtration of sewage to similar treatment of water, and by 1890 the treatment of water by filtration through slow sand filters was fairly well established. The city of Lawrence, then as now, used the highly polluted Merrimack River as a source of wa-

Nitrogen digestion equipment in 1905
Small scale filtration equipment set up on bench at right

ter supply. In 1893, largely as a result of the work at the Station, a slow sand filter was installed to treat the Merrimack River water for domestic use, and the typhoid death rate, which had been very high in the city, immediately dropped. It was partly from observations, not only of reduction of deaths from typhoid but of the general improvement in the health of this city, that Mr. Mills proposed his famous Mills-Reinecke theorem. The theorem holds that improvement in the quality of a public water supply increases the health of the people far beyond the measurable improvement in the water quality.

Studies of the purification of water have continued ever since at the Station. Once it had been shown that the principles of filtration of sewage applied to water as well, a very broad range of investigation was carried on. As early as 1893, chemicals were added to the water "to facilitate better filtration results"; strainers and pre-filters of coke were employed, as was the aeration of chemically treated water by spraying over pebbles. In 1900, dash plate aeration of water, together with the addition of chemicals, was utilized to pretreat water. In 1903, disinfection by calcium hypochlorite was applied to water before filtration. In 1905, a rapid water filter unit was provided with a perforated false bottom. In 1906, it was shown that water pretreated with ferrous sulphate as a coagulant could be filtered at 50 million gallons per acre per day; and, in 1907, a filter was constructed which filtered pretreated river water at 100 million gallons per acre per day, using "backwash of sand when necessary" and, in 1908, surface washing was provided for this same filter. As soon as the gaseous form of chlorine became available, its use was studied; and when modern chlorine feeding apparatus first became available for the treatment of public water supplies, the Department was well provided with information regarding the best use of this disinfection method.

Equipment for preparing culture media in 1905

Scale model of sewage treatment (above the hood) was exhibited at 1892 Columbian Exposition in Chicago.

Section of Bacteriology Laboratory in 1903

Ice-box and gas heated incubator are in opposite corner

Aeration Investigations

Almost from the beginning, the effects of aeration have been studied and many methods of aeration have been used. Submerged aerators constructed of wood or metal, or of bundles of twigs, were explored in 1890. Dropping of sewage from a considerable height, with a resulting increase in dissolved oxygen content was used in pretreatment.

A new turn was given to the use of air in the treatment of sewage, in the years 1910 and 1911, when mixtures of sewage and water (in an investigation of the oxygen requirements of fish ponds) began to develop green growth after continuous aeration. It was soon found that if these green growths were retained in the tanks and fresh sewage was added, stabilization of sewage began to occur with definite oxidation of carbonaceous matter in 4 to 6 hours and nitrification and even complete stabilization after 12 to 24 hours. The sewage thus treated was applied to sand and trickling filters and it was shown possible to obtain greatly increased purification rates. Since this process of "oxidizing" sewage was regarded primarily as pretreatment only, and particularly since the Station failed to offer an attractive and descriptive name, opinion as to whether or not the activated sludge process originated from this work at Lawrence has been divided. There can be little

doubt however that the 1910 to 1912 investigation at the Experiment Station greatly contributed to the development of this modern method of treatment.

Working Quarters

The first laboratory was a rather extemporaneous structure and during several spring freshets of the Merrimack River, the building and grounds were flooded. Finally, following a very severe flooding in 1901, it was decided to erect a newer building farther up the river bank.

In 1903 the first part of the present structure was erected. This was a small wooden shingled building of two rooms for chemistry and two rooms for bacteriology, a small office and an attic, with a total working space of not much more than a thousand square feet. This was originally connected by an open staircase to the experimental areas below. Very soon thereafter the first extension was placed on this building; since that time a total of seven additions have been made. The resulting building is rather sprawling, and lacks the modern conveniences of air conditioning and ventilation. It is now almost completely packed with apparatus and equipment, in which field the Station has kept strictly abreast of the times. Lawrence, therefore, now has an obsolete, cramped, but still useful structure housing the most modern of sanitary analytical equipment.

In 1941 a sum of money had been set aside for a practical rebuilding of the old Station, but Pearl Harbor put an end to this project. Following World War II several proposals were made to the Legislature for a new building and finally, in 1951, something over $400,000 was appropriated for the erection of a completely new structure. About 2.5 acres of land has been secured on the opposite side of the Merrimack River. The location is near two sewers, permitting an uninterrupted supply of sewage for experimental purposes, and is conveniently situated on a main highway. The building will be near many of the city's industries, which will facilitate a study of industrial wastes—now one of the main concerns of the Station.

Plans have been completed and accepted for a two-story and basement structure containing a total of 24,000 square feet of useful floor surface. The building will be completely equipped with modern apparatus and will afford space not only for continuation of the previous work, but will provide adequate space for air pollution studies and for increased work on radioactivity.

The area for sewage, water and waste investigations will include almost 2000 square feet of floor space and will be two stories high to permit the erection of suitable experimental apparatus and equipment. Adequate demonstration and laboratory space, as well as room for the use of sanitary engineers, has been provided. It is expected that the new building will be in use in the summer of 1953. Much of the apparatus and equipment will be moved from the old Station but, as yet no consideration has been given to the fate of the old structure where so much work has been done.

It seems quite appropriate that the Lawrence Experiment Station will be located on Shattuck Street.

References

1. Report of the Sanitary Commission of Massachusetts, by Lemuel Shattuck and others. 1850

2. Report of the Massachusetts State Board of Health, 1890, p. 8 et seq.

3. Gordon M. Fair, Sanitary Engineering in a Changing World. Sewage and Industrial Wastes, *22*, 11, (Jan.) 1950

[An article describing the new Lawrence Experiment Station will be prepared by Mr. McCarthy for publication in *Water & Sewage Works* when the station begins the second phase of its life.—The Editors.]

Water Rate Increase Brings in Millions

Public Works Commissioner Hewitt has estimated that water collections by the City of Chicago will total 28 million dollars this year, compared with $21,833,316 in 1951. His estimate was based on a projection of collections during the first seven months this year totaling $16,229,163, compared with $10,913,613 in the corresponding 1951 period. The increase is due largely to a 50 per cent increase in water rates last September.

British Study Drift of Oil From Sea to Beaches

British experts will make a two-month study of the drift of crude oil and fuel oil discharged from ships at sea that fouls the nation's beaches.

Their mission—dubbed "the Kon Tiki experiment," after Thor Heyerdahl's famous South Sea study of tidal currents—is being sponsored by British shipowners. The scientists and shipping experts will use a special observation ship.

The general council of British shipping has set up a special policy committee to re-examine "as a matter of urgency" practical measures to deal with oil pollution.

"The Kon Tiki experiment" hopes to find out whether oil discharged at sea hundreds of miles from Britain can cause pollution of British shores and whether oil deposited just outside the prescribed fifty-mile radius disperses and becomes harmless before reaching land.

But, remember Mom, there's a water shortage—so, I just dampened the tub a little.

In the New York Manner!

To get the full impact of the following advice to those annoyed by dripping or dribbling faucets the reader should know that New York City has but little familiarity with water meters in private homes or apartment houses.

An illuminating recommendation appeared recently in a Sunday supplement of a New York City newspaper, under the heading "Handyman." Here is what was offered readers as a measure to eliminate the annoying sound of dripping or dribbling faucets. The advice—

> "Just tie a string to the leaking faucet. If the string reaches to the bottom of the sink the leaking water will then run silently down the string and the faucet will no longer be annoying."

The Parabolic Flume
For Sewage and Sludge Measurement

by FRANK L. SOMMER, *Engr., Simplex Valve & Meter Co., Philadelphia, Pa.*

ACCURATE flow measuring devices are a recognized necessity for proper controlled operation of sewage and waste treatment plants. Their use provides—the index whereby variations in the general plant operation can be made to accommodate greater or lesser flows; in part a basis for the accurate control of chemical and chlorine dosage so vital in maintaining the desired biological efficiency; and the permanent flow records needed to evaluate the overall operation of the plant in terms of the change of loading over an extended period thereby enabling the owner to predict and prepare for the need of future increased capacity.

Basically, flow meters fall into two categories—(1) single head measuring devices which are those used for the measurement of flows through open channels or partially-filled pipes —(2) pressure differential types which are used for the measurement of fluids under pressure.

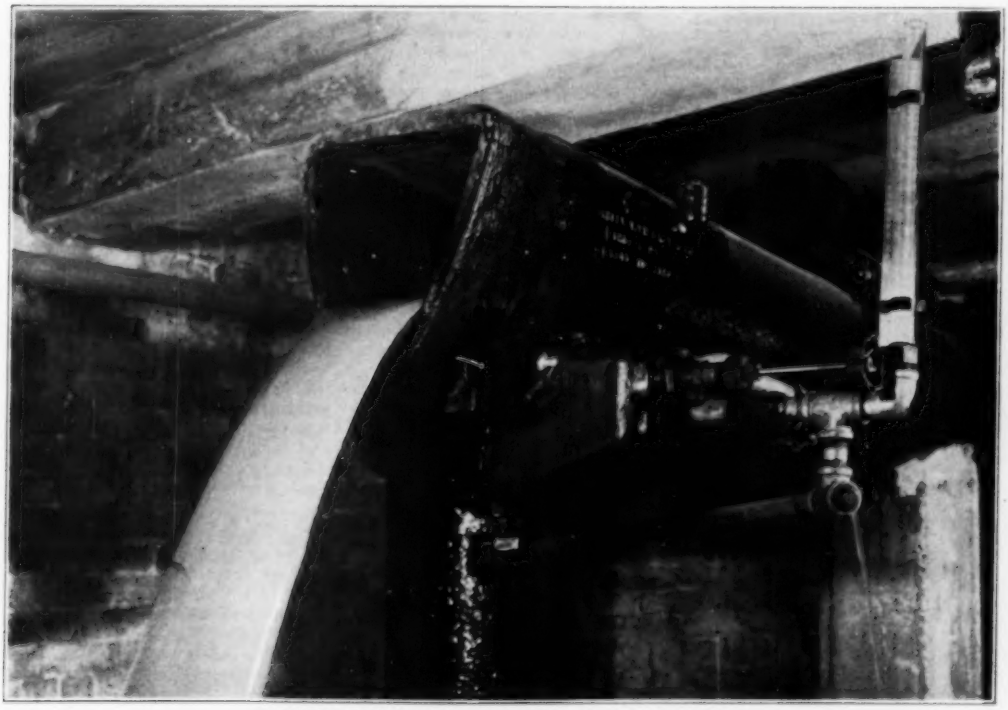
The former category, which is the subject of this paper, includes such actuating—or "primary devices" as the weir, the Parshall Flume, the Builders-Providence Kennison Nozzle and the Simplex Parabolic Flume. No attempt will be made in this paper to discuss or evaluate the Kennison Nozzle other than to mention at this point that there are major differences both in construction and field installation requirements between the Kennison Nozzle and the Parabolic Flume. The major points discussed under the section of this paper concerned with the Parabolic Flume will not necessarily apply to the Kennison Nozzle.

In order to better understand the application and advantages of the Simplex Parabolic Flume it would be well to first briefly discuss other single head measuring devices.

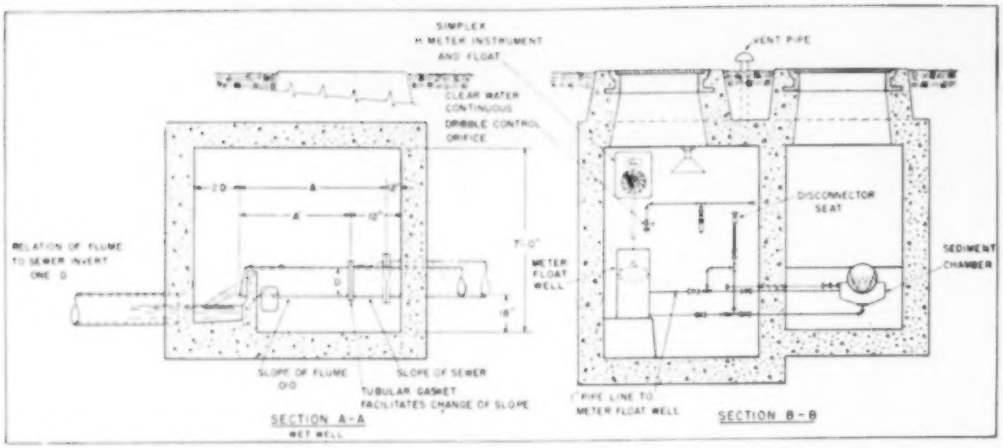
The Standard Weir

All of you, I am sure, are familiar with the use of the weir for this purpose. In our field, weirs are usually of the rectangular or triangular notch type, though these are not the only types of weirs that can be used for flow measurement.

*This paper, presented before the N.J. Sewage & Industrial Wastes Assn., has been released for publication in *Water & Sewage Works*.



PARABOLIC FLUME—Collingswood, N.J., Sewage Treatment Plant.



TYPICAL APPLICATION of Simplex Parabolic Flume on a sewer with wall mounted recording meter in sub-surface dry vault.

Complete methematical data in the form of head-quantity tables, as well as easy to use curves, are available for weirs of standard types. To obtain the best accuracy it is necessary to make certain mathematical corrections depending upon approach conditions, whether or not the weir has end contractions, etc. Accuracy is also dependent upon the presence of air beneath the falling sheet.

The weir does have certain advantages. Foremost is its simplicity, since in itself it is simply a metal plate with an accurately cut notch. Further when installed under proper conditions it is reasonably accurate over small flow ranges. Chief among the disadvantages is the necessity of relatively low velocities upstream which can sometimes only be provided by wide, lengthy approach channels. There is also the possibility of solids accumulation upstream of the weir which naturally cause meter errors. There is also the factor of dependence for accuracy on field structures.

The Parshall Flume

Another type of device that has been used to some extent in our field is the Parshall Flume, usually of concrete construction. A single tap is taken at the invert of this device at a predetermined point between inlet and throat, with the water level at this point used as the flow measuring index. In this case the head is the actual distance between floor and liquid surface.

As to advantages, this device has been proven reasonably accurate and there is sufficient rating and dimensional data available for general use. It further is subject to only a small head loss.

There are some important disadvantages however; namely the need for special attention to the approach conditions; dependence on accuracy of concrete form work; inability to measure low flows due to the wide surface at the measuring point; and the fact that being of concrete makes its critical measuring points subject to eventual erosion. The disadvantages of possible error in the concrete form work and probable eventual erosion can be eliminated through the use of metal flume liners usually fabricated of stainless steel or aluminum. These are manufactured under careful shop-control and are arranged for anchoring in the concrete flume structure. Their dimensions are ample to cover the critical flume sections thus insuring exact final field dimensions of these points. Liners, while of obvious advantage for any Parshall Flume installation, still cannot improve the inherent range limitations of this type of primary device caused by the wide flat surface at the measuring point and the corresponding minute level changes at low flow rates.

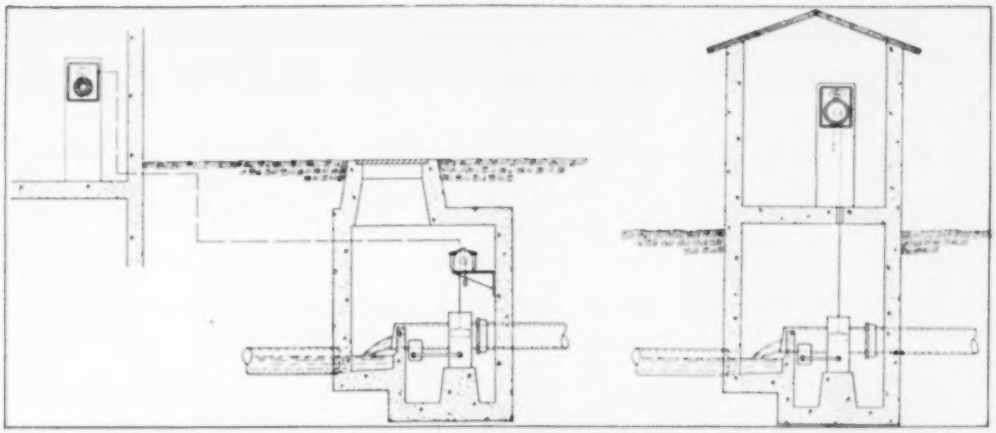
The Parabolic Flume

The need for a better single-head measuring device was obvious as more and more problems relating to measurement of flow in open channels and partially filled pipes were encountered. It was recognized that such a new device would have to have the following features if it were to be an improvement over existing devices. These features include (1)—accuracy over a wide flow range; (2)—a design that would prohibit accumulation of solids so often encountered in field conditions; (3)—should be relatively simple to install and maintain; (4)—require little or no change in the approach conditions. With these objectives in mind the Simplex Parabolic Flume, as we know it today, was developed over a period of years.

The initial unit, fabricated in 1938, utilized a deflection vane at the outlet end. The vane was free to move and subject to the impact of the discharge from the flume. This became known as the Impact Flume. The vane position, which varied with the flow and the corresponding liquid levels at the outlet end of the flume, was the index of the flow rate and through direct mechanical linkage it operated the secondary indicating and recording instrument.

As is the practice with all of our products, several of the impact flumes were rated at the University of Pennsylvania hydraulics laboratory prior to the date units of this type were finally sold. During these early ratings an intuition prompted measurement of the height of water at a certain distance back from the outlet. These heights were found to be an even better index of the accompanying flow rates and following further tests and field experience the vane was abandoned in favor of the use of the liquid level for meter operation. Thus the Type S Parabolic Flume came into being.

During the war years when production was devoted primarily to defense work few of the new Parabolic Flumes were made, though engineering design of the flume as presently built was completed. As we now know it, the Parabolic Flume (see illustration) when used for the more common applications is constructed



TYPICAL APPLICATIONS of Simplex Parabolic Flumes. (Left) with electric transmission of flow rates to meter instrument. (Right) with meter instrument located in housing above flume-vault.

of cast iron. It has a circular inlet and a smooth, gradual transition to an outlet of parabolic form. The laying length is equal to approximately four times the inlet diameter. This is worthy of note, since the gradual transition over this distance provides for an increase in velocity as the liquid flows through the flume, thus making the flume self-scouring. Since there are no inward projecting parts nor pockets, the design eliminates any possibility of solids build-up. The measuring tap which reflects the liquid level, hence the flow rate, is fixed at a predetermined distance upstream of the outlet. The tap is bronze bushed and is provided with a hand-operated cleaning valve to prevent clogging. The take-off tap leads to the important roomy sediment trap, cast integrally with the flume, where any solids which enter the tap can accumulate and eventually be blown off. This prevents solids from entering the small piping to the meter float well. The Simplex Parabolic Flume is equipped with a gauge glass and scale indicating the flow rate. This can be used for meter setting and adjustment or as an actual flow indicator should a secondary instrument not be desired. All flumes also include backflushing disconnector assemblies for periodic backflushing of the sediment trap and piezometer tap with clear water, and leveling pins to simplify the final field setting.

Due to the parabolic shape at the measuring section (see illustration) this flume serves for accurate flow measurement over a full 20 to 1 range, since the cross-sectional area provides for substantial change in head at low flow rates.

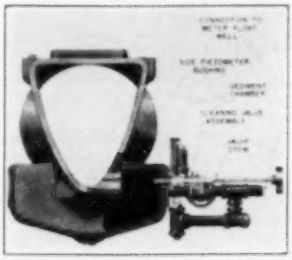
Installation of the Flume

The flume can be installed at the end of a line having any grade within reasonable limits and is provided with bell, spigot, or flanged inlet as required. Where the flow range requires the use of a flume a size smaller than the pipe line itself, this is accomplished by immediately preceding the flume with a standard eccentric reducer to which the flume can be joined.

For best results installations should provide for a free fall at the flume outlet such that the minimum distance between the flume outlet invert and the discharged liquid level downstream is one inch approximately. This arrangement is not an absolute necessity, however, since the flume will retain its high degree of accuracy under conditions of slight submergence.

Applications

In the municipal field this device has and is being used for a variety of applications. Due to its wide flow range and relative ease of installation it is ideal for measurement of sewage flow in zoned areas of a collector system. In the sewage plant itself it obviously has a multitude of applications.



DETAILS in cut away section of Parabolic Flume tube, showing sediment chamber, cleaning valve assembly, connection for gage-glass to indicate flow rates, etc.

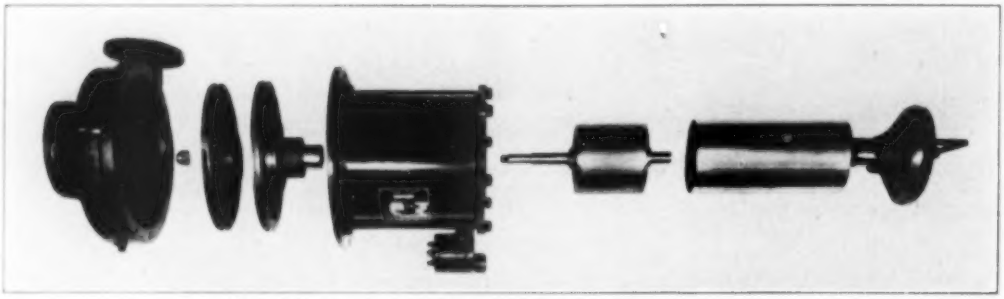
It has also been rapidly accepted for varied process and waste measurements in industrial plants. For example, it is now being used for the measurement of—sewage, waste liquors, alkalies, various chemical and trade wastes, milk wastes, and for one industrial user the measurement of process acids. In the latter case flumes were constructed of antimony lead to resist the corrosive effects of the liquid being handled. At present there are over 80 Parabolic Flume installations with the number of units being sold each year increasing.

Before closing this discussion I'd like to tell you about the recent My. Ephraim, N.J., installation, which is one of the most unusual we've encountered to date. Called in to offer recommendatitons we found that the customer particularly wanted to measure the sewage flow to the dosing tank. During the course of years the dosing tank area had been found too large for the volume of sewage being handled. Then above at the dosing tank outlet end a smaller tank had been built within the larger structure. In order to bring the sewage to the new tank a 20-25' length of 12" pipe was installed between the concrete channel to the old structure and the present tank. Since there was an ample free fall at the discharge end of this pipe, the Parabolic Flume was ideal for the application. However it was found that it would be impossible to attach the flume to the

end of the 12" line, due to interference of one of the side walls, the angle of the wall and pipe being such that had the line been carried approximately 2" further it would have passed through this wall. Since it would have been very difficult to re-locate the 12" line, it was decided to install the flume by attaching a one eighth bend to the end of the line. It was recognized that the head-quantity laws derived from extensive laboratory rating would probably be affected by the ⅛ bend immediately upstream. The flume was accordingly rated at the University of Pennsylvania hydraulic laboratory under conditions identical to those which would be encountered and the secondary meter was designed accordingly.

In conclusion it can be stated that the Simplex Type S Parabolic Flume is designed specifically to measure accurately over a wide range the flows of various liquids in channels, sewers, or partially filled pipes where free flowing conditions exist. The flume has become a recognized and accepted form of primary device to obtain accurate measurements of flow, particularly under adverse conditions where previously recognized forms of instrumentation could be applied only with great difficulty or expense, if at all.

Chempump – New Seal-less Centrifugal Pump



Disassembled Chempump reveals simplicity of design and relatively few parts.

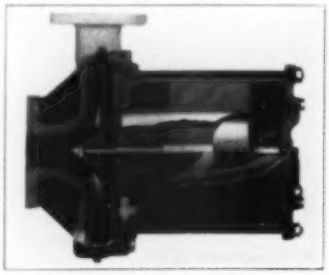
The wraps were officially removed from a radically new centrifugal pump at a press conference in New York City on August 5th. The pump is Chempump, and its outstanding feature is a magnetic drive.

Chempump's basic design provides only one moving part—a combined rotor-impeller, magnetically driven and properly aligned at all times. It employs a standard impellor rotating in a standard volute pumping chamber having a standard flanged suction.

What sets Chempump apart from all other centrifugal pumps, however, is the fact that it has eliminated seals and stuffing boxes, and requires no external lubrication. This has been accomplished by using a stainless steel cylinder to isolate the stator from the rotor, and by plating or "canning" the rotor to protect it from action by the liquid pumped. Because the fluid handled can circulate freely in the rotor chamber, no packing is required, leakage is eliminated, and there is no loss of horsepower due to stuffing box friction.

The photograph of the disassembled Chempump illustrates the pump end section with intake and discharge ports; the acorn nut for fastening impeller on rotor shaft; the face plate with bearing partially set in rear of plate; Chempump housing containing stator; the "canned" rotor; the stainless steel sleeve; and the rear endbell with recirculating line attached.

The cutaway view of the Chempump illustrates the relation of all parts in the finished pump. Bearings provided are molded graphite of extreme hardness, and this pump assures proper bearing alignment at all times. The bearing assemblies can be inserted and removed by hand and without special tools—thus the only portion of the unit needing replacement due to wear can be replaced quickly and inexpensively.



Cutaway View of Chempump

At present, Chempump units are available in 1, 2 and 3 horsepower sizes, and will soon be offered in larger sizes. The pump can be mounted and operated in any position or location. Chempumps will not compete in first cost with conventional centrifugal pumps, but savings due to installation, maintenance, and leakage reduction advantages can easily justify their use. They are suitable for handling many corrosive liquids.

For the information of our readers, we note that complete details concerning this pump and its special applications may be obtained from the makers, Chempump Corp., 1300 E. Mermaid Lane, Philadelphia 18, Pa.

How-to-do-it Manual Designed for Industrial Waste Surveys

"Planning and Making Industrial Waste Surveys" is described as a manual for the conduct of a liquid-waste study in a manufacturing plant. It was prepared by the Metal-Finishing Industry Action Committee of the Ohio River Valley Water Sanitation Committee.

There are 46 pages of practical information in this excellently organized and illustrated handbook. The methods of measuring flow volume, obtaining representative samples, and calculating waste loads are designed for plant operating men who may be called upon to do the job.

Copies of the manual are available at $1.00 each from the Commission at 414 Walnut Street, Cincinnati 2, Ohio.

Central States Sewage Works Ass'n Holds Silver Anniversary Meeting

Presidents

Retiring	Incoming
M. L. Robbins *Chemist* *Sanitary Distr.* *Minn. St. Paul*	*Wm. W. Mathews* *Supt.* *Sanitary Distr.* *Gary, Ind.*

THE twenty-five year old Central States Sewage and Industrial Wastes Association celebrated its Silver Anniversary at its 1952 annual meeting held in Madison, Wisconsin, June 26-27, at the Hotel Lorraine.

Of the 189 members and guests attending the Silver Anniversary meeting only 18 were present at the 1931 meeting held in Madison twenty-one years ago. These "old-timers" were the subject of a special group picture which accompanies this report, as does the old group picture made during the first meeting in Madison.

A feature of the Silver Anniversary meeting was the appearance of the Governor of Wisconsin, Walter J. Kohler, Jr., who made an exceptional address of welcome in which he exhibited a decided interest in the work of members of the Association and a keen insight into the matter of stream pollution and pollution abatement. Without question Governor Kohler's address was the most understanding and appreciative of any which has been our privilege to hear a high official give before any water and sewage works group. His interest was genuine and his audience thoroughly appreciative.

Another feature was the review by Dr. Floyd W. Mohlman of "A Quarter of a Century of Sewage Treatment in the Central States."

A Silver Anniversary brochure, recounting the history of the Association and entitled "25 Years of Progress" had been prepared by Walter A. Sperry as editor and L. E. Langdon as business manager for distribution to the membership. Both received a special vote of appreciation for this excellent memento.

Awards

The Radebaugh Award, established in honor of Gus Radebaugh, first secretary of the Association, was voted to Paul E. Langdon of Greely & Hansen, Engrs., for his paper "Sewage Disposal for Tampa, Florida" which was printed in Sewage Works Journal.

Secy.-Treas.
Paul Troemper
Engineer
Ill. San. Wtr. Bd.
Springfield, Ill.

Nat'l. Director
Dr. W. D. Hatfield
Supt.
Sanitary Distr.
Decatur, Ill.

The Arthur S. Bedell Award, in memory of the second president of the Federation of Sewage Works Ass'n wase voted to Don E. Bloodgood, Prof. of Sanitary Engineering at Purdue Univ. in recognition of his leadership and the success of the Purdue Conferences on Industrial Wastes.

Business Session

Members of C.S.S.&I.W.A. learned from Secy.-Treas. Paul Troemper that the Association enjoyed a 46 member gain during the year to net a membership of 564. Wisconsin boasts the largest number of members per 1000 population in the state with Illinois second, Indiana third and Minnesota fourth. Membership

Vice-Presidents

(First)	(Second)
E. Hurwitz *Chemist* *Sanitary Distr.* *Chicago*	*O. J. Muegge* *Chief Engr.* *Wis. Dept. Hlth.* *Madison*

merit awards went to George Schroepfer and George Bernauer for having brought in the largest number of new members within the year.

Members learned from the Treasurer's Report that the Association is financially strong with $3638.00 in the bank or invested in government bonds.

Officers Elected

Officers elected for the year ensuing were:

President
Wm. W. Mathews, Supt.
Sewage Treatment, Gary, Ind.

1st Vice-Pres.
E. Hurwitz, Chemist
Chicago Sanitary Distr., Chicago

2nd Vice-Pres.
O. J. Muegge, Chief Engr.
Wis. Dept. of Health, Madison, Wis.

3rd Vice-Pres.
A. J. Duvall, Cons. Engr.
Toltz, King & Day, St. Paul, Minn.

Entertainment & Inspection Trips

Entertainment consisted of a Smorgasbord supper the first evening followed by renditions of a barber shop quartet and the Silver Anniversary Banquet the second evening. On both evenings the Clubroom and Social Hour was staged by the manufacturers representatives in behalf of the

Inspection Trip to Madison Sewage Plant and Oscar Mayer & Co. Packinghouse Waste Treatment Plant

Programmers

Arndt J. Duvall
San. Engr.
Toltz King & Day
St. Paul, Minn.

C. C. Ruchhoft
Prin. Chemist
U.S. P.H. Service
Cincinnati, O.

Water & Sewage Works Mfgrs. Assn. under chairmanship of "Bob" Steindorf of Chain-Belt Co. Speaking honestly, this feature would have been much more enjoyable had the weather not been so viciously hot. Nevertheless, the room was packjammed.

Inspection trips included a visit to Madison's Sewage Treatment Plant and to the Waste Treatment Plant of Oscar Mayer & Co., where considerable experimental work is under way, including methods of grease separation from packinghouse wastes and disposal by spray irrigation.

Technical Sessions

"FINANCING SEWAGE TREATMENT WORKS" by Arndt J. Duvall, Consulting Engr. Toltz, King & Day, Inc., St. Paul, Minn.

In a well thought out paper Mr. Duvall expressed the opinion that consulting engineers and state authorities make positive that a needlessly expensive plant for sewage treatment be avoided thus holding down costs of treatment to a supportable basis. The sound principle should be that of providing only the degree of treatment considered a minimum and thereafter add secondary treatment only when and if proven necessary.

Sewage treatment should be financed on a utility basis as the only really sound method. In many cases costs for sewage treatment equal the cost of water supply. In the smaller communities water supply costs less than sewage treatment.

In arriving at the necessary sewer service charge for financing on a utility basis not less than 6% per year on the cost of the installation should be provided. Added to this fixed charge must be the estimated operation and maintenance costs. To be safe a factor of safety should be added. If too much income results it is simple to cut back—not so simple to revise the charge for service upwards.

Mr. Duvall revealed that it is becoming the practice amongst Minnesota towns to establish the sewer service charge sometime before sewage treatment is instituted, the money being impounded in a special account. In other cases water, electricity and sewerage have been combined to facilitate financing and strengthen revenue bond issues to good effects. He cited and recommended the Joint Committee Report on water and Sewage financing published in the Spring 1951 issue of the Ohio State Law Journal under the title "Fundamental Considerations in Rate and Rate Structures for Water and Sewage Works."

An interesting disclosure is the fact that in Minnesota municipalities frequently finance their utilities, if not other operations also, from income in the form of local taxes collected

Programmers

Roy N. Giles
Dir. Tech. Service
Std. Oil of Ind.
Chicago

Dr. F. W. Mohlman
Director Labs.
Sanitary Distr. of
Chicago

Silver Anniversary "Oldtimers" who were in attendance at Madison meeting 21 years ago

FRONT ROW—John C. Mackin, former Supt. of Treatment Plants, Madison, Wis.; L. H. Enslow, Editor, "Water and Sewage Works," New York; W. H. Wisely, Exec. Sec'y, Federation of Sewage & Industrial Wastes Assns., Champaign, Ill.; Walter A. Sperry, Supt., Aurora Sanitary Dist., Aurora, Ill.; E. Hurwitz, Chemist, Sanitary Dist. of Chicago, Ill.; Dr. F. W. Mohlman, Director of Labs., Sanitary Dist. of Chicago, Ill.; O. M. Leonard, Cons. Engr., Michigan City, Ind.; H. Gladys Swope, Chemist, Argonne National Labs., Chicago, Ill.; C. C. Larson, Supt. Water & Sewage Treatment, Springfield, Illinois.

REAR ROW—George W. Martin, Supt. Treatment Plant, Green Bay, Wis.; E. J. Beatty, Supt. Treatment Plant, Urbana, and Champaign Sanitary Dist., Urbana, Ill.; Dr. M. Starr Nichols, Chief Chemist, State Lab. of Hygiene, Madison, Wis.; E. P. Baillie, Chemist, Sewage Treatment Plant, Madison, Wis.; Dr. W. D. Hatfield, Supt., Decatur Sanitary Dist., Decatur, Ill.; C. C. Ruchhoft, Prin. Chemist, U. S. P. H. Service, Cincinnati, Ohio; Henry M. Heisig, Research Chemist, Milwaukee Sewerage Comm., Milwaukee, Wis.; R. T. Steindorf, Div. Sales Mgr., Chain Belt Co., Milwaukee, Wis.; G. R. Barnett, Chemist, Sanitary Dist. of Chicago, Peoria, Ill.

Awardee
Dom. E. Bloodgood
Prof. San. Eng.
Purdue Univ.
Lafayette, Ind.

Program Chm.
G. A. Rohlich
Prof. San. Eng.
Univ. Wisconsin
Madison, Wis.

Vote of Appreciation

W. A. Sperry
Supt.
Sanitary Distr.
Aurora, Ill.

L. E. Langdon
Vice-Pres.
"P.F.T."
Chicago

from retail liquor establishments. The average taken in from liquor sales for all municipalities amounted to $13.00 per capita in 1951 of which $10.00 was the contribution to defraying local government costs. Many of the smaller municipalities have modern sewer systems today only because of the local liquor store revenue.

In the discussion which followed it was deplored that sewage financing did not involve a sinking fund to take care of major replacements, repairs or plant enlargement. The question was raised as to the legality of charging sewer service fees prior to construction of the treatment plant. The only answer was that it has been done in numerous cases without a test case having reached the courts.

lbs. of phenolics and has a population equivalent of 31,500. For the entire country 5,400 bbls. of oil is wasted to streams daily, 130,000 lbs. of phenolics, contribute a population equivalent of 10,500,000.

Mr. Giles, in discussing possible criteria in assessment of pollution abatement needs, listed:

(1) The reasonable use of a stream doctrine.

(2) Health of stream and assimilating capacity.

(3) Present and future pollution loads.

He was pleased to note the trend toward uniformity of regulations in the different states, about half having adopted or simulated the Model Regulatory Act proposed by the U.S. Public Health Service functioning under Public Law 845 which has now been extended for five more years.

Mr. Giles, questioned the feasibility of undue requirements on industry to provide waste treatment to a degree which would entail excessive expense whereas a water treatment plant is capable of producing satisfactory water at a fraction of the cost by employing the necessary chemicals to produce an acceptable water. To require an industrial establishment to spend many times more is not a realistic approach.

In reply to a question "Will the offending industry expect to pay to the municipality affected the added cost for treatment of its water supply?" This one he avoided answering—and for good reason.

Those in attendance at first C.S.S.W.A. meeting held in Madison some 21 years ago

Rational Approach to Industrial Waste Disposal

"A RATIONAL APPROACH IN THE INDUSTRIAL WASTE DISPOSAL PROBLEM" by Roy N. Giles, Director of Technical Service, Standard Oil of Indiana, Chicago, Ill.

Mr. Giles pointed out that the average oil refinery converts 20,500 bbls. of crude, loses 16 bbls. per day, 380

B.O.D. Technique

"STUDIES OF SEEDING TECHNIQUES IN THE B.O.D. DETERMINATION" by R. G. Zehnpfennig, Research Associate, and M. Starr Nichols, Chief Chemist, State Laboratory of Hygiene, Madison, Wis.

This paper comprised a progress report on studies of seeding techniques and incubation periods in the standard B.O.D. test. Based on results the authors believe that 2 day B.O.D. values, with properly seeded samples, have an appeal over 5 day values because of the greater consistency in the results and also because the values are more reproducable in the laboratory.

The author's works was controlled with great care on autoclaved—reseeded samples and the only truly consistent results were obtained on dilutions incubated for 2 days. Not all questions have been answered but evidence to date points to the very probable desirability of reducing the standard incubation period of 5 days to 2 days in order to put the B.O.D. test on a sounder and more practicable basis.

In the discussion which followed it was admitted that the shorter incubation period was to be desired; but, in the case of certain sewages or effluents, such as chlorinated sewage, it would be very questionable that the

flora and fauna could re-establish itself in the 2 day period. Experience, according to Linn H. Enslow, in comparing B.O.D. of settled sewages before and after chlorination the incubation periods on reseeded chlorinated sewages had to be lengthened to 10 or more days before the B.O.D. values could be considered dependable. This fact was very evident in the numerous studies made to determine the effects of chlorine in true reduction of B.O.D. as compared to the apparent reduction created by the suppressed bio-activity caused by chlorinated compounds in the sewage.

Algae Control

"Studies Seeking Chemicals Possessing Selective Toxicity to Blue-Green Algae" by G. P. Fitzgerald, G. C. Gerloff and Folke Skoog, University of Wisconsin, Madison, Wis.

In this excellently prepared and well presented paper a carefully documented report was rendered on the results of an investigation aimed at finding selective algacides which would control blue-green algae without destroying fish and other desirable aquatic life.

In all, 300 chemicals were tried in comparison with copper sulphate. Quarternary ammonia compounds were very effective at 0.1 to 0.2 ppm. Most effective of all compounds were the Napthaquinones and amongst these 2-3 Dichloro Napthaquinone proved the *most* effective. Dosages of 2 parts per billion after 10 minute contact proved ample for the blue-green algae. Interestingly, in the dark it had no effect but upon exposure to daylight this small dosage became 100% effective.

Temperature effects were pronounced. At 25° C. twice the dosage is required as at 35° C. In amounts destroying blue-green algae (2 parts per billion or thereabouts) fish showed no distress. Field tests are now under way to determine costs and practicability of use on a full lake scale. The 2-3 Dichloro Napthaquinone has been named "23" for short and was procured from the U.S. Rubber Co. In comparison with copper sulphate 0.2 ppb will do the same job as 2 ppm of the copper salt.

Milk Waste Reductions

"Reducing Milk Waste in Dairy Plants" by V. Schwartzkapf, Lathrop-Paulson Co., Chicago, Ill.

The author of this paper described an improved system of drainage and rinsing of empty milk cans, which has reduced waste materially while also reducing stream pollution or loadings on treatment plants. He told of studies which had developed the optimum method and time of can drainage. On the average for every 1000 can of 10 gal. size when hand drained 406 lbs. of whole milk goes down the sewer. With the mechanical (timed) method, described, this 406 lbs. is reduced to 65 lbs. A further reduction is possible but is not economically feasible.

Disposal of Radio Active Wastes

"Biological Treatment Methods in the Disposal of Radioactive Wastes" by C. C. Ruchhoft and L. R. Detter, U.S.P.H. Service, Cincinnati, Ohio.

Mr. Ruchhoft reviewed methods of disposing of radioactive wastes at

Local Arrangements

T. F. Wisniewski
Chief Engr.
Pol. Control Bd.
Madison, Wis.

R. T. Steindorf
Div. Mgr.
Chain Belt Co.
Milwaukee, Wis.

points of production. The most widely used method to date is that of evaporation and burial of residues in marked burial areas. Disposal at sea in deep water has considerable promise as a safe method. Chemical precipitation processes at Los Almos, employing heavy dosages of iron coagulants and lime to pH 11 to 12, produced effluents safe for drinking. Ion exchange for some wastes proved excellent but too expensive.

As to studies of biological treatment, activated sludge effected 95% removals but require addition of nutrients such as glucose and phosphates. Sewage does not provide sufficient nutrients. For Iodine-131 very little radio-activity accumulated in the sludge. Trickling filters, with a recirculation ratio of 8 to 1 in two stages, proved satisfactory for laundry decontamination wastes. In all instances the presence of sufficient phophorous is the important criterion in either the activated sludge or trickling filter process. In the activated sludge process 4 hrs. of aeration produced a 77% reduction, whereas 24 hrs. was required for a 10% increase in reduction i.e. 77% to 87%.

25 Years of Progress

"A Quarter of a Century of Sewage Treatment Developments in the Central States" by Dr. Floyd W. Mohlman, Director of Laboratories, the Chicago Sanitary Distr., Chicago.

Dr. Mohlman's excellent review of developments during the past 25 years in sewage treatment in the states of Illinois, Indiana, Wisconsin and Minnesota, comprising the area of the Central States Assn., was followed with great interest.

Beginning with 1928 separate digestion of sludge at Antigo, Wis., created quite a sensation. He mentioned that in the period 1928-1932 Chicago's new Northside Activated Sludge Plant went into service. Childs and Schroepfer made their outstanding study of the Mississippi River below St. Paul, which definitely set the requirements for sewage treatment for Minneapolis and St. Paul. Because that study revealed the sufficiency of primary treatment it has saved tax payers millions of dollars. Milwaukee developed methods of screenings digestion. Chemical treatment was reincarnated at Dearborn, Mich., along with the proven practicability of vacuum filter dewatering and sludge incineration under Mark Owen. Sludge gas for power production was established on a practical basis by Walraven at Springfield, Ill. Treatment of packing plant waste by super-chlorination was developed under Halverson at Austin, Minn. Thermophyllic digestion was tried but the odor problem defeated it.

In the period 1932-1937 the Guggenheim Process of combination chemical precipitation and aeration came into being and was discarded after a thorough study by The Chicago Sanitary District. The Minneapolis-St. Paul Treatment Plant, providing primary treatment with facilities for chemical precipitation at times of low river flows, went into operation. Packinghouse waste treatment advances were made at Madison, Cedar Rapids and Sioux Falls. High rate trickling filters were developed and proven by Halverson and others. Mallory introduced the "Equilibrium Index" for control of the activated sludge process and Erp Thomas offered sludge humification with thermophyllic bacteria. "Tapered Aeration" was promoted by the Chicago Pump Co.

During the period 1938-1942 new plants at Gary and Fort Wayne, Ind., and at Kenosha and Menasha, Wis., went into operation—also the "World's Largest Treatment Plant" at Chicago. The Haves Process came into being and the Darr "Vaccuator" was introduced.

In the next five years 1942-1947 the activated sludge process was

streamlined by Gould and co-workers for N. Y. City. Industrial wastes received increased attention and the Standard Oil Co. of Indiana installed the largest A.P.I. Oil Separator Plant. The Lewis Chemical Precipitation Process was offered and thoroughly tested at Atlanta. Grease recovery from sewage was in the spot-light, but was short lived.

During the past four years 1948-1952 the U.S. Public Health Service expanded notably under Public Law 845 dealing with abatement of stream pollution, while much progress was being made by industry in pollution abatement. Foaming of activated sludge plants became a problem of widespread importance. Methods for removal of cyanides and chromium from electroplating wastes were perfected and widely adopted. Small sewage treatment plants increased noticably as did the sewer service charge for financing sewage treatment.

In mentioning men in the Central States area who have left their imprint Dr. Mohlman named T. Chalkley Hatton of Milwaukee; Childs & Schroepfer at Minneapolis and St. Paul; John Mackin, Sr., at Madison, Wis.; Radebaugh at Champaign; Harry Ferguson at Springfield, Ill.; Paul Hansen of Chicago; Cecil Calvert of Indianapolis.

Dr. Mohlman, in closing, gave some of his thoughts on the Activated Sludge Process which he became closely identified with as early as 1914. He deplores the tendency to shorten the aeration period and the reduction of solids carried in the areation tanks to 500 ppm. or less. Sludge age is of less importance than it is increasingly believed to be. Experience indicates the importance of the Sludge Index as the most effective indicator in controlling the process and observing the direction in which it is going before real trouble appears.

Operator's Discussion Panel

The forenoon of the closing day, beginning with breakfast, was devoted to discussion of operator's problems led by an Operator's Panel consisting of Geo. W. Martin of Green Bay, Wis., L. S. Kraus of Peoria, Ill., O. B. Carpenter of Hammond, Ind., K. L. Mick of St. Paul, Minn.

Membership Award Winners

Geo. J. Schroepfer
Prof. San. Eng.
Univ. Minn.
St. Paul, Minn.

Geo. F. Bernauer
Engineer
Wis. Dept. Hlth.
Madison, Wis.

Operator's Panel Discussion Leaders

L. S. Kraus
Ch. Chemist
Sanitary Distr.
Peoria, Ill.

Geo. W. Martin
Supt.
Sewage Treatment
Green Bay, Wis.

C. B. Carpenter
Supt.
Sanitary Distr.
Hammond, Ind.

K. L. Mick
Supt. & Engr.
Sanitary Distr.
Minn.-St. Paul

What is Activated Sludge?

This question was thrown into the ring by **L. S. Kraus,** Supt. of Treatment at Peoria, Ill., who to start the ball, said that his thought was that B.O.D. removals of 30 lbs. or less per 1000 cu. ft. of air would be activated sludge whereas removals above 30 lbs. and up to 90 lbs. per 1000 cu. ft. is representative of modified activated sludge. Others, however, believed that both are activated sludge.

H. W. Wisely, Secy. Sewage Works Federation, was of the opinion that regardless of what it may be called any variation of the process which spells economy is the desired end. He would prefer to see researchers start out without prejudice and see what modifications can be developed.

Wm. W. Mathews, Supt., Sanitary District of Gary, Ind., expressed the opinion that the only way to analyze performance of activated sludge plants is on a day to day basis. For a consistenly good effluent one could not count on air use of less than 500 cu. ft. for each pound of B.O.D. removal. A yardstick of performance which he had found highly useful at Gary is the unit of pounds of B.O.D. reduction per hour per 1000 cu. ft. of aeration capacity. For example: With aeration tank capacity of 800,000 cu. ft. and an aeration period of 5 hrs., if the total B.O.D. removal for the 24 hr. period was 40,000 lbs. the computation would be as follows:

$$\frac{40{,}000}{5 \text{ hrs.}} = 8{,}000 \text{ lbs./hr.}$$

$$\frac{8{,}000}{800} = 10 \text{ lbs./hr./1000 cu. ft.}$$

This value may be termed the P.H.C. factor of plant performance, which will reveal varying efficiencies.

The chief value of carrying high solids in the aeration tanks seemed to be its shock absorption value, provided the sludge could be maintained in good condition.

Krause agreed with Mathews in his opinion that 500 cu. ft. of air per pound of B.O.D. removal constituted sound operation but had found that at times good performance could be had with 1.5 to 2 hrs. aeration period with air use of only 300 cu. ft. per pound of B.O.D. removal under the Peoria system of operation.

Wm. D. Hatfield, Supt., Decatur, Ill., Sanitary Distr., prompted by the Peoria experiences involving the feeding of digestion tank liquor to the aeration tanks, cited an instance where the sludge digester was unknowingly bleeding into the aerators. The results spoke for themselves at this plant. In such a case he had found that sludge re-aeration even to the extent of 33% of the aeration tank capacity proved beneficial. He had also learned that starting with sludge from digesters in the aeration tanks is the quickest and easiest way to develop an activated sludge—not in weeks, but in 2 days. In such case the solids in the aeration tank liquor ran to 3,000 ppm. and the B.O.D. removal at 50 lbs./1000 cu. ft. of air input. The sludge reaeration period was about 14 hrs. These observations were in the nature of a confirmation of the results obtained under the method of operation developed at Peoria.

C. C. Larson, Supt. of Water and Sewage Treatment, Springfield, Ill., could not be sold on the arguments for Modified Activated Sludge, since his long experience with the Springfield plant had indicated that it was impractical to stop short of full activated sludge operation. More B.O.D. removal for the dollar resulted from complete activated sludge treatment for the bulk of the sewage, and giving the remaining portion of the sewage primary treatment only, than to attempt to give the entire flow a modified activated sludge treatment.

W. E. Ross
Supt.
Sewage Treatment
Richmond, Ind.

F. I. Vilen
Supt.
Sewage Treatment
Kenosha, Wis.

R. E. Anderson
Engineer
N. Shore San. Distr.
Waukegan, Ill.

R. W. Frazier
Supt.
Sewage Treatment
Oshkosh, Wis.

Discussion Participants

Linn H. Enslow, Editor of *Water & Sewage Works* said that he would like to add further confusion to the pros and cons of activated sludge by recalling the method of operating the London, Ontario, activated sludge plant which had proved the most effective for this plant some years ago before it was enlarged. What the present method at London is he was not certain of and history might be out of order. However, at the time, the process was one of many hours of sludge re-aeration which some termed a method of "wet-burning" of sludge solids. In any event the period of aeration of the mixed liquor (returned sludge and settled sewage) was on the order of minutes rather than hours—something like 40 minutes. The mixed liquor solids settled rapidly and were returned promptly to the re-aeration units. The effluent was superior to that from orthodox activated sludge operation.

[Ed. Note: Taking into consideration the remarks concerning activated sludge and methods of operation, it is still evident that sewage treatment must "rest on its own bottom," and there still appears to be many "bottoms."]

What of Trickling Filters?

George W. Martin, Supt. of Sewage Works, Green Bay, Wis., introduced the topic of Trickling Filters by reporting on the results from 3 ft. deep experimental trickling filters at Green Bay. The first unlooked for result was the absence of any increase in efficiency when testing recirculation. The settled sewage applied varied between 200 and 400 B.O.D. At loadings of 9 mgd/acre, representing an average loading of 2500 lbs. of B.O.D. per acre ft., the effluent was consistently good day in and out. Recirculation resulted in no greater B.O.D. removals, but did have the advantage of better distribution, cleaner distributor arms and less fly breeding. Later, Mr. Martin stated that at temperatures below 50 F. there could be observed a difference during recirculation but at 50 F. and upwards there was no difference of consequence.

L. E. Langdon, of "P.F.T." said that he had not observed any real value from recirculation as far as B.O.D. removals was concerned, even with sewages up to 800 B.O.D. He cited the South St. Paul plant, handling mostly packinghouse waste of 800 B.O.D. and 1500 lbs./acre-foot loading without recirculation.

Walter A. Sperry, Supt. of Treatment at Aurora, Ill., said that Aurora had never had a fly nuisance and that he had never been able to find any correlation between film character on the stones and effluent quality.

C. C. Ruchhoft, Principal Chemist, U.S.P.H.S. pointed to the zooglea in trickling filters as the all important element affecting performances.

W. D. Hatfield said that no psychuda fly nuisance was experienced at Decatur because of the high frequency of spraying—once every 5 minutes.

H. W. Wisely, in reverting to the recirculation question, felt that at Paris, Ill., the value of recirculation had been demonstrated in regards B.O.D. removals. He, himself, was all for trickling filters, feeling that in most every instance they would produce an effluent adequate for the situation at hand.

Geo. F. Bernauer, Wis. Dept. of Health, complained of effluents from high-rate filters because of their appearance and the fact that he had found none of 35 ppm. B.O.D. or better.

Linn H. Enslow, *Water & Sewage Works* in a comment on effluent quality and standards for effluents and pollution loadings on streams, felt that consideration of plant effluents on the basis of parts per million and appearance alone was not an adequate standard.

The only justifiable consideration is that of stream loading (pollution) in total pounds of B.O.D. or other loading per day. The only thing that counts is the effects of pollution on appearance of the stream and the total oxygen depletion. The matter of effluent appearance, or the fact that it may not be up to some standard in parts per million, considered permissive, has little significance without evaluation of the stream loading in pounds per day of the undesirable material. This basis of evaluation seemed even more important in dealing with industrial pollution than in the case of municipal pollution. Perhaps we are paying too high a price for appearance of effluents and values measured in the laboratory, rather than in nature.

H. W. Wisely rose in support of Enslow's views pertaining to effluent standards and need for the additional measure of pounds per day stream loading as the only realistic limitation standard.

Effects of Industrial Wastes on Sewer Systems

Carl B. Carpenter, Supt. of the Sanitary Distr. of Hammond, Ind., introduced this topic by telling of Hammond's experience with oil wastes from five industrial plants. By securing cooperation of these industries alleviation had resulted through better internal "housekeeping" by the industries.

R. E. Anderson, San. Engr., No. Shore San. Distr., Waukegan, Ill., related an instance where wastes from penicillin production had created a problem in sewage plant performance. New standards of the Ill. Sanitary Water Board for effluents and beach protection made improvement of effluent mandatory. Result had been a penicillin waste recovery operation by the producers, now converting these wastes into chicken feed.

[Ed. Note: For Mr. Anderson's work in connection with this and other problems of a similar nature he received a citation from the Ill. State Sanitary Water Board, as recounted in our June issue.]

Wm. E. Ross, Supt. of Sewage Treatment at Richmond, Ind., a charter member of the Association, said that ordinances prohibiting industrial loadings on sewers were good to have but a cooperative attack of the problem had yielded better results in Richmond. Shock loads created by industry dumpings had been the serious matter. Through cooperative dealings he had been successful in getting holding tanks installed by the worse offenders. With this accomplished, additional improvements in the way of better internal plant operations to reduce the waste was the less difficult to secure.

Frank I. Vilen, Supt. of Sewage Works at Kenosha, Wis., whose plant is known as Kenosha "Water Supply Protection Works," has found the

major industries cooperative. Kenosha has used the Federal Model Ordinance as the basis for a local ordinance for control of sewer use by industry. Kenosha industries have established an Engineering Committee which meets with Kenosha officials to reach an understanding and effect improvements. Dr. Mohlman, serving as consultant and adviser to the Engineering Committee of Industry, has suggested improvements but advocates measurement of added loadings on sewage treatment be taken at the "point of initial dilution" in the sewer, rather than in terms of waste at point of entry into the sewer. What this matter of "point of initial dilution" means was not clear to those present.

[Ed. Note: Replying to a letter of inquiry addressed to Dr. Mohlman, he defines the "point following initial dilution" as that point on a sewer, downstream from the point of waste entry, at which thorough mixing of sewage and waste has taken place. At this point of sampling a fairer evaluation of actual loading imposed on the sewage treatment facilities can be had. This observation has been made by others, notably by the International Joint Commission for boundary waters in its 1951 report.]

Plant Protection Against Floods

Kirwin L. Mick, Supt. and Chief Engr., Minneapolis-St. Paul Treatment Works, introduced this topic by telling of experiences during the flooding of the Mississippi which reached a stage 2.5 inches above the previous record flood of 1881 and put 4 ft. of water over the sewage plant grounds. Notwithstanding this, because of carefully worked out plans made in 1949 the plant kept operating. On some of the tunnels there was 28 ft. of head. Mr. Mick, in an article published in *Sewage Works Journal*, has told of operations involved in getting prepared for such a flood and how the details were worked out. We will not attempt to repeat here all that was done. Brick walls hurriedly constructed at points held under a 10 ft. water head. Such walls were built across ramps leading to basement garages and elsewhere. Ground level windows were eliminated and at many points where pipes ran through walls chinking was required. Many of the operating personnel lived within the plant. The only ingress and egress was by small boats discharging passengers and supplies through windows. All doors were sealed with oakum and asphalt. The foresight of planning for such an emergency in 1949 paid off and prevented a plant shut-down.

Shots on the Inspection Trip

Carl A. Wahlstrom, City Engr. at La Crosse, Wis., experienced as the principal difficulty that of keeping the sewers flowing. To do this nine additional emergency pumps were installed and a permanent emergency pumping station is now being contemplated. The 2 mile dyke protecting the plant proved sound and no water entered the grounds.

Walter A. Sperry of Aurora, Ill. related a different sort of experience when snow drifts on the roads kept operators out of the plant for 3 days.

L. H. Enslow commented on an unusual sort of flooding problem now threatening sewage plants on Lake Michigan. Just recently the excessive height of the lake level, together with a wind and low pressure atmospheric conditions, actually caused the lake to flow back into the Milwaukee plant for an hour or so. Government engineers predict a still higher lake level during 1952 and Milwaukee is faced with taking steps to keep the lake out of its sewage plant. The ultimate solution would seem to be lake level control by the Army Engineers which will temporarily, at least, give Chicago more dilution water for its sewage effluents through the Chicago Drainage Canal and other canals.

Unique Professional Card

Elmer Ross, Supt. of the new sewage treatment plant of the East Bay Municipal Utility District in Oakland, Calif., has a unique and useful professional card reproduced above.

The card, of standard size, symbolizes quality and has embossed in blue and gold the seal of the East Bay Utility District in the upper left corner. It folds at the center. When opened up one finds a location map which shows the recipient of the card just how to find the Sewage Treatment Works of the East Bay District. And, as if to invite inquiries and visitors, the telephone number of the plant appears on the card.

Mr. Ross is the contributor of an article, revealing a novel hydraulic method for lifting heavy sluice gates. This interesting article is shortly to appear in *Water and Sewage Works*.

Any OLD Water To Sell Today?

University of Chicago scientists recently inserted a want ad in Chicago newspapers asking for samples of Chicago water not less than five but no more than 20 years old.

The "middle-aged" water is required for studies of naturally-occuring radioactive tritium, the heavy radioactive form of hydrogen.

In response to their ad, the scientists have received samples of water from an undertaker's fire extinguisher, a grocer's soda pop cooler, a chemistry teacher's hot water heating system and a housewife's water jug. So far, though, they have been unable to obtain a large enough single sample whose age is authentically known. They would like a minimum of thirty gallons, because the tritium they seek to study exists in extremely minute quantities in water of this age.

The experiments for which the "middle-aged" water is required are intended to check the accuracy of the method of dating samples of water.

THE EDITOR'S COMMENTS

The Care and Feeding of Laboratories

Call it Experiment Station or Research Project, locate it on the Atlantic Coast or on the Pacific—these are laboratories practically identical in aim and spirit.

For examples we cite two articles: one the story in this issue of the Lawrence Experiment Station of the Massachusetts Department of Public Health; the other is that published last month describing the Sanitary Engineering Research Project of the University of California.

These laboratories are representative of American research in the treatment of water, sewage, and industrial wastes. They came into being to meet an evident need for practical study and demonstration of treatment methods. Our laboratories have made and will continue to make vital contributions to progress in sanitation. For it is in laboratories that nature reveals its secrets.

In point of time, laboratories exemplified by the Experiment Station and the Research Project are infant laboratories. They are growing, but never grow old. Their every investigation is a progress report because no study remains final and complete. This must be so because new types of pollution come into being and new methods of control must be developed in laboratories.

Let it be clearly recognized that pollution can neither be eliminated nor conquered. It can be restricted, but the menace will be ever present. Measures for the correction and control of pollution must come from our laboratories. Those with authority over programs for the purification of water and the abatement of stream pollution must be made aware that only well-cared-for laboratories can provide the vitally needed information.

The mental requirements of our laboratories are even more important, for laboratories are nothing without men. Sixty-six years ago, Lawrence put to work young sanitary engineers, chemists, and biologists. Three years ago, the Research Project selected specialists in the same fields. To these has been added, in each instance, technical men trained in the new science of radio-activity.

The reasons why our laboratories develop such valuable information in the field of sanitation are not hard to find. Above all else, these laboratories are impartial. The life of a laboratory is spent in asking questions and seeking true answers. Laboratories never learn all the answers—in fact, they never learn all the questions to ask.

Our laboratories are workshops, and the information developed there provides the tools with which problems of pollution may be solved. These are the tools which must be used by officials, engineers, and plant operators who originate very little, but apply a great deal.

To make the control of pollution a working reality, therefore, the need for laboratories will never end. We recommend that our laboratories be well cared for by those in charge. Our hopes for the future are in these labratories.—H. A. F.

Needed; New Yardsticks

It is true, as stated in the foregoing editorial, information and methods developed in our laboratories serve as all important tools for use by engineers, chemists, plant operators and stream control agencies. But, it is also becoming increasingly apparent, as pointed out by Hedgepeth in an article in this issue on "Realism vs Dogma" in pollution problems of industry, that "sooner or later the industrial waste worker runs into the stubborn fact that sanitary engineering methods and judgment, based upon a background of experience and knowledge drawn from water and sewage work, are not entirely suitable when applied to the industrial pollution problem."

In support of such contention Hedgepeth points to the discovery that the procedures given in the official "*Standard Methods*" for determining the chlorine demand of municipal sewages and effluents are inapplicable to industrial wastes with which he has had to deal. Depending upon which of the two alternate procedures appearing in "*Standard Methods*" should be used the industrialist in question could be billed by the sewer authority at the rate of $175,000 annually, or at the rate of $25,000 per year. The question is which, if either, of the official procedures is to be considered applicable. To the industrialist paying the bill, this is no minor question.

Further on Hedgepeth cites the fact that the standard B.O.D. test also constitutes a questionable yardstick in evaluating industrial loadings on sewage treatment processes or stream loadings. This test, which has served pollution control authorities and plant operators well in dealing with municipal pollution and treatment plant operation, "is now being prostituted by sanitary engineers and chemists for the purpose of setting stream standards and drawing certain statistical conclusions for administrative convenience" in connection with industrial pollution control work.

Amongst other observations Hedgepeth points out that the use of the standard B.O.D. test as a yardstick for evaluating stream loadings by industry in terms of "population equivalents" is creating resentment in industry. This term he refers to as an "unlovely hybrid" when applied to industry's pollution status.

Further, it is his stated belief that factual evidence indicates the need for pollution control authorities and sanitary engineers becoming more realistic and objective in their thinking, discarding many older concepts.

Considering the background of training and experience which Mr. Hedgepeth has to his credit, his expressed opinions and revealing comments on the thinking of industry deserve more than ordinary consideration.

There is still work for the laboratories in the matter of developing methods, procedures and standards which will serve as more adequate and dependable tools and yardsticks in the industrial pollution control work that lies ahead.

L. H. Enslow

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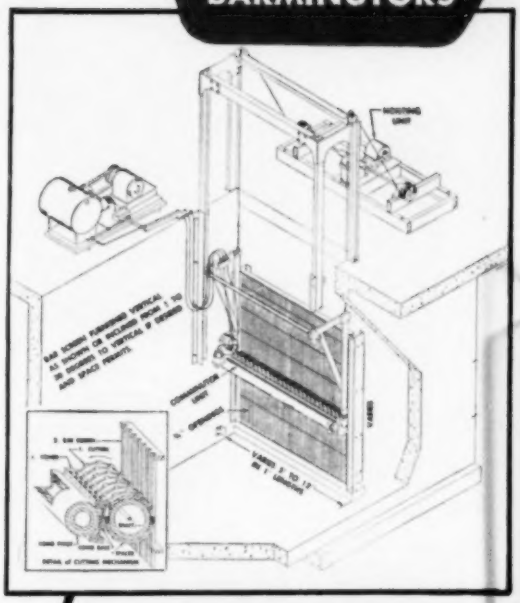
Chicago BARMINUTORS



Chicago Pump, the company that developed and perfected the Comminutor, announces the new Chicago Barminutor for plants with flows of 15 MGD and over. The Barminutor combines the function of a bar screen with the unfailing performance of the Comminutor. It can be installed in existing open channels. Complete technical data sent upon request.

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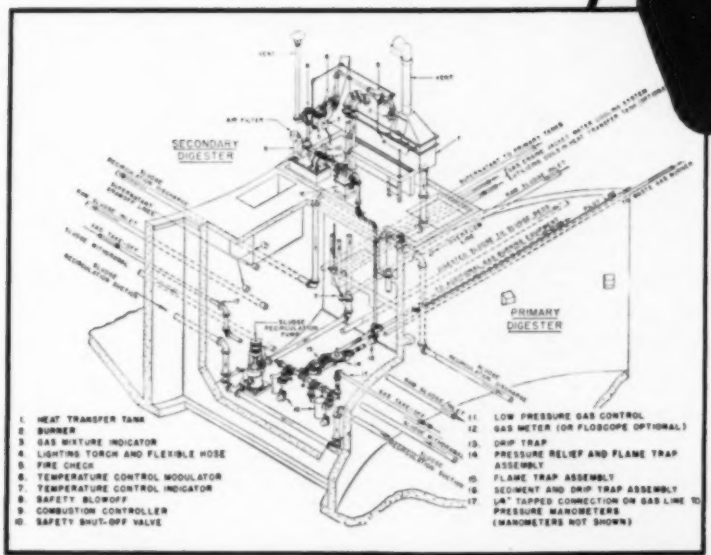
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9. COMBUSTION CONTROLLER
10. SAFETY SHUT-OFF VALVE
11. LOW PRESSURE GAS CONTROL
12. GAS METER (OR FLOSCOPE OPTIONAL)
13. DRIP TRAP
14. PRESSURE RELIEF AND FLAME TRAP ASSEMBLY
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Meetings Scheduled

Sept. 3-13—Chicago, Ill. *(Conrad Hilton)*
AMERICAN SOCIETY OF CIVIL ENGINEERS. (Centennial Celebration). Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

Sept. 8-10—Groton, Conn. *(Hotel Griswold)*
NEW ENGLAND WATER WORKS ASSOCIATION (Annual Meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Sept. 8-10—College Park, Md. *(University of Maryland)*
MARYLAND-DELAWARE WATER WORKS SCHOOL. For further information, write McLean Bingley, 2411 No. Charles St., Baltimore 18, Md.

Sept. 9-11—Grinnell, Iowa *(Grinnell College)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, Leo Holtkamp, Box 310, Webster City, Iowa.

Sept. 10-12—Sioux Falls, S.D. *(Hotel Cataract)*
MINNESOTA SECTION A.W.W.A. Sec'y, L. N. Thompson, Water Dept., St. Paul, Minn.

Sept. 15-17—Knoxville, Tenn. *(Andrew Johnson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, R. P. Farrell, Dept. of Public Health, 420 6th Ave., Nashville, Tenn.

Sept. 15-17—Reading, Pa. *(Abraham Lincoln Hotel)*
PENNSYLVANIA MUNICIPAL AUTHORITIES ASSOCIATION. Sec'y, Claude C. Fogelman, 1717 Main Street, Northampton, Pa.

Sept. 15—Cheyenne, Wyo. *(Frontier Hotel)*
ROCKY MOUNTAIN SEWAGE WORKS ASSOCIATION. Sec'y, C. E. Harness, 272 City & County Bldg., Denver, Colo.

Sept. 16-17—Cheyenne Wyo. *(Frontier Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.

Sept. 16-18—Madison, Wis. *(Hotel Loraine)*
WISCONSIN SECTION A.W.W.A. Sec'y, L. A. Smith, City Hall, Madison 3, Wis.

Sept. 17-19—Pierre, S. Dak. *(Hotel St. Charles)*
SOUTH DAKOTA WATER & SEWAGE WORKS CONFERENCE. Sec'y, Charles E. Carl, State Board of Health, Pierre, S.Dak.

Sept. 18-19—Cincinnati Ohio *(Netherland Plaza Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 21-23—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. MISSOURI WATER & SEWAGE CONFERENCE. Sec'y, W. A. Kramer, State Office Bldg., Jefferson City. Mo.

Sept. 24-26—Battle Creek, Mich. *(Post Tavern)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

Sept. 24-26—Atlanta, Ga. *(Georgia Institute of Technology)*
GEORGIA WATER & SEWAGE WORKS OPERATORS' SCHOOL. Sec'y, N. M. deJarnette, Dept. of Public Health, Atlanta, Ga.

Sept. 25-27—Winnipeg, Man. *(Royal Alexandra Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. (1 day Operators' School, Sept. 24). Sec'y, F. M. White, 301 Hamilton Bldg., Winnipeg, Man.

Oct. 2-3—Parkersburg, W.Va. *(Chancellor Hotel)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, H. K. Gidley, State Dept. of Health, Charleston, W.Va.

Oct. 2-4—Parkersburg, W. Va. *(Chancellor Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Act. Sec'y, Glen O. Fortney, State Dept. of Health, Charleston, W.Va.

Oct. 6-9—New York, N.Y. *(Statler Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION (Annual Meeting). Exec.-Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill. (and) NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. Sec'y, Ralph C. Sweeney, 21 N. Broadway, White Plains, N.Y.

Oct. 8—Bethel, Maine
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, Winthrop Water District, Winthrop, Me.

Oct. 12-15—Tulsa, Okla. *(Mayo Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, L. A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 14-17—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, W. A. Kufs, 510 Telegraph Bldg., Harrisburg, Pa.

Oct. 20-22—Pittsburgh, Pa. *(Wm. Penn Hotel)*
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec'y, William Porter, Wm. Penn Hotel, Pittsburgh 30, Pa.

Oct. 20-24—Cleveland, Ohio *(Public Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Oct. 21-22—Fredericton, New Brunswick *(Lord Beaverbrook Hotel)*
MARITIME BRANCH CANADIAN SECTION A.W.W.A. Sec'y, J. D. Kline, P.O. Box 574, Halifax, N.S.

Oct. 23-25—Atlantic City, N.J. *(Hotel Madison)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Oct. 23-24—Portland, Ore. *(Multnomah Hotel)*
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Robert O. Sylvester, More Hall, University of Washington, Seattle 5, Wash.

Oct. 23-25—Mason City, Iowa *(Hanford Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 28-31—Pasadena, Calif. *(Huntington Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, John C. Luthin, 1113 Laurent St., Santa Cruz, Calif.

Oct. 29-31—Washington, D.C. *(Wardman Park Hotel)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl L. Lauter, 6955 33rd St., Washington, D.C.

Nov. 3-5—Montebello, Quebec *(Seigniory Club)*
CANADIAN INSTITUTE OF SEWAGE & SANITATION. (Annual Meeting). Sec'y, Dr. A. E. Berry, Parliament Bldgs., Toronto, Ont.

Nov. 5-7—Old Point Comfort, Va. *(Chamberlin Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, W. H. Shewbridge, Regional Engr., 708 State Office Bldg., Richmond, Va.

Nov. 10-12—Hendersonville, N.C. *(Hotel Skyland)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N.C.

Nov. 16-19—Pensacola, Fla. *(Hotel San Carlos)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, C. W. White, State Board of Health, 519 Dexter Ave., Montgomery 4, Ala. (Joint Meeting).
FLORIDA SECTION A.W.W.A. Sec'y, M. R. Boyce, 504 Pennsylvania Ave., Clearwater, Fla. (Joint Meeting).
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSN. Sec'y, Donald P. Schiesswohl, P.O. Box 210, Jacksonville, Fla.

Dec. 4-6—Havana, Cuba
CUBAN SECTION A.W.W.A. Sec'y, L. H. Daniel, Baratillo 9, Havana, Cuba

Dec. 7-10—Cleveland, Ohio *(Hotel Cleveland)*
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. (Annual Meeting). Sec'y, F. J. Van Antwerpen, 120 East 41st St., New York 17, N.Y.

Dec. 10—Winthrop, Maine
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, Winthrop Water District, Winthrop, Me.

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Malcolm Pirnie Engineers Announces New Partners

Malcolm Pirnie Engineers, Consulting Civil and Sanitary Engineers of New York City, has announced that three associates have become members of the partnership.

In addition to Malcolm Pirnie and Ernest W. Whitlock, the firm now includes the three new partners: Robert D. Mitchell, Carl A. Arenander, and Malcolm Pirnie, Jr.

Assn. of Corrosion Engrs. Moves Headquarters Office

The Central Office of the National Association of Corrosion Engineers has announced that they have moved to larger quarters at 1061 M. & M. Building, No. 1 Main Street, Houston 2, Texas. The move was made necessary by the need for additional office space to accommodate the growing work of the association.

YOU AND YOUR JOB

Don't ever belittle the job
that you fill;
For however little your job
may appear,
You're just as important as
some big gear
That meshes with others
in some big machine
That helps keep it going
though never is seen.

They could do without you,
we'll have to admit
But business keeps on even
when the big fellows quit!
Your job is important;
don't think it is not,
So try hard to give it the best
that you've got!
If they didn't need you,
you wouldn't be there,
So, always my lad,
keep your chin in the air.

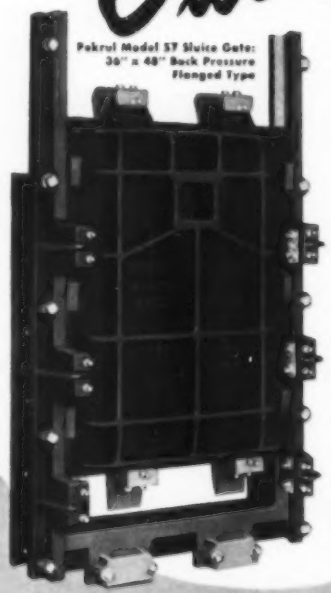
[This is a portion of a poem (author unknown) that was quoted in a paper "You and the Water Works Industry" by C. G. Shipley, Plant Supt., Charleston, S.C.]

Planning for Prolonged Drought in Tidal Delaware River

Industries and municipalities that depend upon the Delaware River below Trenton-Morrisville have been notified that the flow of fresh water into the tidal section of the Delaware has dropped below the minimum rate which would be maintained under the four-state water conservation program recommended by the Interstate Commission on the Delaware River Basin (INCODEL). James H. Allen, Incodel's executive secretary, in issuing the notice stated that the flow in the Delaware will continue to fall lower and lower over the next three months unless there are unseasonable rains in store for the region.

The purpose of alerting the municipalities and industries, Allen said, was to enable their representatives to make their own studies of the effect of a prolonged drought, should it occur, on the use of the waters of the tidal section of the Delaware for municipal and industrial water supply and for the discharge of treated sewage and industrial wastes. Allen asked those to whom the notice was sent to keep the fact in mind that, while the Fairless Works of the United States Steel Company and other large industries now locating

Pekrul
Gates



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Rearing Ponds
Recreation Pools
Cooling Towers
Steel Mills

PEKRUL GATE DIVISION

MORSE BROS. MACHINERY
DENVER, COLORADO

Write for Catalog 49

in the Greater Philadelphia region were not operating this year, they would be before another summer rolls around.

Municipalities alerted were Philadelphia, Bristol and Chester in Pennsylvania, and Burlington and Camden in New Jersey. Among the industrial companies to which the notice went were United States Steel, U.S. Pipe and Foundry, Scott Paper, American Viscose, Ford Motor, Sun Ship, Sun Oil, Sinclair Oil, Atlantic Refining, Campbell Soup and RCA Victor.

The notice was also sent to all members of the committee, headed by Albert M. Greenfield, which was appointed in June 1951 by Governor Fine to make an independent appraisal of the Incodel plan.

Syncrogear Motor Movie

A new movie in color and sound featuring the development and application of internally-geared electrical motors has been produced by U.S. Electrical Motors, Inc. It was made to enlighten engineers desirous of learning how best to apply geared power and to more fully understand the design and characteristics of motors in the geared classifications. This 20-minute film shows dramatic close-ups of U.S. Syncrogear Motors under construction and installed for numerous applications.

Pickups from "Sanitary Engineering News"

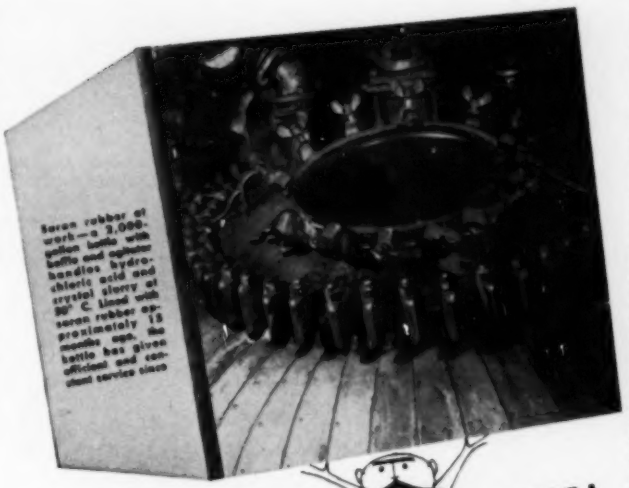
Don. E. Bloodgood, Editor

New wearing rings installed on three sewage pumps at Jackson, Mich. increased the output from 11 m.g.d. to 13 m.g.d.

Anaerobic methane bacteria appear to be suitable for treatment of citrus waste water but essential oil from citrus fruit appears to be toxic to anaerobic bacteria.

Anaerobic digestion of meat packing wastes has been investigated at a packing plant in Austin, Minn. over the past three years. Sounds promising.

A key to successful composting has been found in moisture control. Organic material has been observed to decompose slowly if at all at moisture contents outside the range 65 to 85 per cent. Would sewage sludge decompose still more if maintained in this range?


Saran rubber at work—a 2,000-gallon tank with baffle and agitator handles hydrochloric acid and crystal slurry at 90° C. Lined with saran rubber approximately 15 months ago, the tank has given efficient and constant service since

BOOST EQUIPMENT LIFE!

use

SARAN

RUBBER TANK LINING!

The productive life of costly equipment often can be lengthened through the installation of saran rubber tank lining. Saran rubber's high degree of chemical and abrasive resistance makes it an effective lining wherever the corrosive inroads of grease, many solvents, acids and other chemicals should be checked.

Saran rubber tank lining helps bring lower operating costs to industries handling, storing or transporting corrosives. The lining can be applied easily and economically by experienced applicators located strategically throughout the country. Get in touch with an applicator today by contacting your nearest Saran Lined Pipe Company office.

for tank cars
storage tanks • tank trailers
processing tanks
production tanks

RELATED PRODUCTS

Saran rubber molded parts—stoppers, diaphragms, various-sized moldings for valves, instruments, etc.

Saran lined steel pipe—corrosion-resistant pipe that gives long-term operation with minimum maintenance costs.

Write to the Distributor:

SARAN LINED PIPE COMPANY

2415 BURDETTE AVENUE • FERNDALE, MICHIGAN

Offices in: New York • Boston • Pittsburgh • Tulsa • Philadelphia Chicago • Portland • Indianapolis • San Francisco • Houston • Denver Los Angeles • Seattle • Cleveland • Charleston, S.C. • Toronto • Montreal

Saran Lined Pipe Company
2415 Burdette Avenue, Ferndale, Michigan

Please send me your catalog on Saran Rubber Tank Lining and Saran Rubber Molding Stocks.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

SARAN RUBBER

DOW

product

Of all utilities, water works have the greatest accident-frequency rate. Why?

Head losses in air lines can be calculated by $p = \frac{0.0625Lv^2}{(25000\ d)}$

v = velocity of air, ft./sec.
L = length of pipe, ft.
d = inside diameter of pipe, inches.
p = pressure loss in lbs./sq. inch.

Activated sludge has been reported to contain appreciable quantities of Vitamin B_{12}.

Tampa, Fla. is one of a very few cities to finance its entire sewerage-expansion program, including both sewers and treatment works, entirely by means of revenue certificates. (Ed. Note: Declared legal by Florida courts.)

"Use of lagoons for either digested or undigested sludges, in most cases has resulted in complaints due to odors. Therefore, lagoons cannot be considered as a suitable permanent means of disposal, except in very isolated locations", by Samuel Zack—Where has he been?

"I NEVER CONNECT IN THE WRONG HOLE- with FLEXICROME SEWER-ROD COUPLINGS!"

Pats. 2,110,202 2,471,060

Greatest Improvement Since the Coupling Itself!

This improved coupling for HIGH SPEED POWER TURNING MACHINES never assembles in the wrong (lock pin) hole, making it necessary to uncouple to use a lock pin. Saves time and money. CLICK, SNAP — IT'S HOME. "FLEXICROME" ROD —made exclusively for Flexible — is used exclusively. They are interchangeable with all "OLD STYLE" Flexible Rods.

"OLD STYLE" Rods and Couplings can still be furnished to cities that still turn their rods by hand (the slow, expensive way). Expect as good results as you had 15 YEARS AGO.

Just move coupling in or out of the ratchet or power drive shaft—pressing pin down till it clicks. Then turn right or left for hole.

WRITE today

"FLEXIBLE"
SEWER-ROD EQUIPMENT CO.
9033 VENICE BOULEVARD, LOS ANGELES 34, CALIF.

41 Greenway St. — Hamden 14, Conn.
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29 Cordan Avenue — Roslindale 31, Mass.
801 E. Excelsior Blvd. — Hopkins, Minn.
3786 Durango St.— Los Angeles 34, Calif.
4455 S. E. 24th Street — Portland, Oregon
Francis Hankin—Montreal & Toronto, Can.
351 West Jefferson Blvd. — Dallas, Texas

AMERICA'S LARGEST MANUFACTURER OF PIPE CLEANING TOOLS AND EQUIPMENT

Manufacturers & Equipment News

New Bubbltrols for Liquid Level Control

901

Automatic Control Company, St. Paul, Minnesota, has developed the Autocon Bubbltrol, which replaces floats and electrodes with a simple, maintenance-free bubbler system that requires no cleaning or adjustment.

Autocon Bubbltrols are used for vented tanks, sumps, reservoirs, deep wells, etc., and operate by forcing air (either from the Bubbltrol's built-in air compressor, from plant air supply or from a bottle-gas unit) through a vertical pipe dropped into the liquid to a pre-determined level. Variations in liquid level produce corresponding variations in the air pressure required to maintain bubbling. This air pressure is applied to the twin bellows type pressure-operated controls or gauges built into the unit to start and stop pumps, open and shut valves, provide continuous indication, operate telemetering apparatus, etc.

Long Elected Vice Pres. of American Cast Iron Pipe

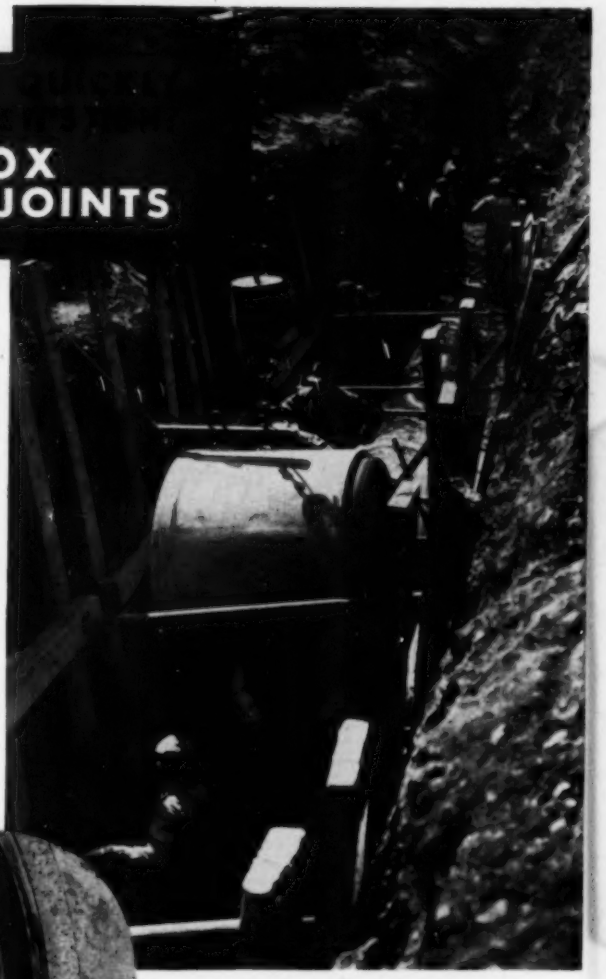
American Cast Iron Pipe Company, Birmingham, Ala., has announced the election of Lester Long as vice president in charge of sales and secretary of the company. He will also serve on the Board of Directors and on the Board of Management.

Mr. Long has been connected with the company for the past 37 years, having been assistant general sales manager since 1931. He was first employed at Acipco in the Experimental

(Continued on page 100A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

TYLOX RUBBER JOINTS



COVINGTON'S 42" concrete sewer on Second Street, laid in connection with Kentucky's Flood Wall Project, posed some tough problems for the Army Engineers in charge.

The sewer paralleled the Ohio River. The ditch was wet, it had to be sheeted and braced, the pipe swung into position, coupled and the ditch back-filled as quickly as possible to prevent cave-in.

Not only did the line have to be laid in a hurry — it had to be tight and stay tight in the face of shifting soil and soil stresses. Leaky joints could seriously affect the efficiency of the flood wall.

Tylox-coupled joints were specified, for rubber gaskets are a natural on tough jobs like this. Big bore sewer pipe can be coupled faster with rubber joints than any other way. And because there is no waiting for grout to harden before inspection can be made, back-filling can proceed immediately. The compression seal formed by Tylox gaskets assures a water-tight line; the flexibility of the joint enables the line to withstand soil stresses, helps make sure the line stays permanently tight. For a permanently tight sewer line — there's one sure answer: Tylox rubber joints.

MAKING JOINTS WITH TYLOX RUBBER GASKETS IS AS SIMPLE AS ABC

Cement tongue and snap on Tylox gasket.

Lubricate sliding surfaces with Tylox Cement.

Shove the pipe home.

Write, wire, or phone for Specification Data and Literature on Tylox Gaskets.

HAMILTON KENT MANUFACTURING CO.

220 GOUGLER AVE. KENT, OHIO TEL. 3449

"THE ONLY PERMANENTLY TIGHT LINES ARE LAID WITH RUBBER JOINTS"

(Continued from page 98A)

Dept. and worked in several other places in the plant before being transferred to the Sales Dept. in 1918.

Ampcoflex Rigid Plastic

902

Atlas Mineral Products Company, Mertztown, Pa., has announced that as a result of a three year intensive research and development program it now has available Ampcoflex rigid plastic.

Ampcoflex is a rigid plastic material available as extruded pipe with molded fittings, formed containers and fabricated tanks, as well as square and round duct sections in standard sizes. Non-standard units can also be designed, engineered and fabricated at the Mertztown plant.

Chain Belt Appoints Additional Distributors

Chain Belt Company, Milwaukee, Wis., has announced the appointment of the following distributors for products of the Chain & Transmission Division, Conveyor & Process Equipment and Baldwin-Duckworth Division of the Company.

Seaboard Brass & Copper Company, 236-238 North Franklintown Road, Baltimore 23, Maryland.

B. & H. Machine Sales, 370 Woodmere Street, Detroit 9, Mich.

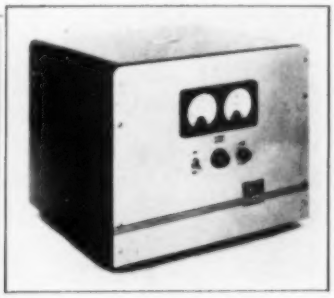
Morrison Harvester Supply Company, 217 E. Alder St., Walla Walla, Washington.

Transmission Equipment Company, 1200 Muriel St., Pittsburgh 10, Pennsylvania.

Divine Engineering, Inc., 315 Seventh Avenue, S.E., Cedar Rapids, Iowa.

Beaty Machine Works, 17-23 South Second Street, Keokuk, Iowa.

Impact Insurance Against
1—LOSS OF FIRE PROTECTION.
2—EXCAVATION AND PAVEMENT REPLACEMENT.
3—COSTLY REPAIRS INVOLVING MAJOR HYDRANT COMPONENTS.
4—FLOODING.
The Smith Protectop Hydrant is designed to permit rapid return to service at minimum cost when a Hydrant is damaged as a result of a traffic accident.
The Protectop Hydrant Standpipe and Valve Stem are equipped with Special Couplings located just above the ground. The Couplings withstand operating pressures and ordinary impact with an ample factor of safety. Under excessive impact occasioned by traffic accidents the Couplings fracture at the design points thus minimizing the damage and permitting speedy return to service at low cost.
All Smith Hydrants are equipped with Compression Type Valves which definitely eliminate flooding since the line pressure holds the Valve against its seat in the closed position.
Write for details.
THE A.P. SMITH MFG. CO.
EAST ORANGE, NEW JERSEY



Battery Power Regulator for DU Spectrophotometers

903

Beckman Instruments, Inc., South Pasadena, Calif., has developed a new Battery Power Regulator that assures sustained accuracy and minimum battery maintenance when making measurements with Beckman Model DU Spectrophotometers.

This new accessory permits the operator to exercise precise control in regulating the charging unit so that the battery can be supplied with the exact amount of current needed for operating the instrument.

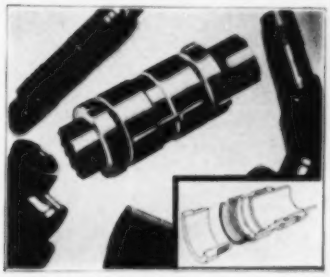
M. B. Mac Neille Honored by A.S.M.E. Life Membership

M. B. Mac Neille, Manager, Pump Division, A. Y. McDonald Mfg. Co., has been awarded life membership in the American Society of Mechanical Engineers in recognition of loyal

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

and effective service to the Society over a long period of years. The gold membership card, indicative of this status, was presented to Mr. Mac Neille at a meeting of the Iowa-Illinois Section of the Society, held in Moline, Ill.

Mr. Mac Neille has been a member of the American Society of Mechanical Engineers since 1921, was an affiliate in the old Gas Power Section much earlier. He has been active on the Society's Power Test Code Committee and on committees dealing with the standardization of flanges, flanged fittings and welded fittings.



Extra-Strong Rigid Plastic Pipe

904

Carlon Products Corp., Cleveland, Ohio, has developed an improved Carlon "L" rigid plastic pipe and a new compression type coupling which incorporates a radically different design.

Characteristics of this new pipe and fitting include increased resistance to burst, high tensile and flexural strengths, greater chemical resistance, the ability to withstand sunlight, and the greatest life expectancy of any rigid plastic pipe.

Carlon "L" rigid pipe is recommended for cross-country piping, lawn sprinkler systems, land drainage, and processing on exhaust lines handling highly corrosive fumes, gases and vapors. It resists the effects of sunlight and can be assembled and disassembled rapidly.

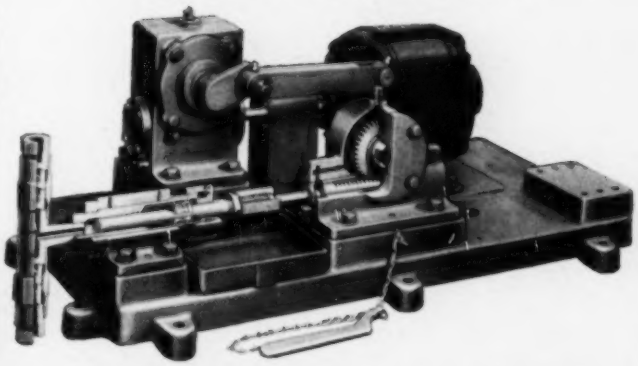
Graver Expands Technical Organization

Graver Water Conditioning Co., New York, N.Y., has announced the expansion of its technical organization.

A new Research and Product Development Department has been created under the direction of Vincent J. Calise, who has developed many of the company's equipment designs.

(Continued on page 104A)

For precisely controlled metering and proportioning of small volume flows...



...the HILLS-McCANNA "U" Type Proportioning Pump

• The Hills-McCanna "U" Type Pump is designed to continuously meter and proportion small flows of the order of 0.10 to 24 gallons per hour per feed. Its accuracy and reliability suit it for research, pilot plant operation and full scale processing alike. The "U" type pump is suitable for batch or continuous operations.

Typical examples of "U" type pump applications include:

• Continuous addition of air entraining agents during cement manufacturing operations.

• Continuous injection of internal phosphate treatment and sodium sulphite oxygen scavenging in boiler plant water treatment.

• Injection of gasoline gum inhibitors into finished gasoline.

• Proportioning low molecular weight polymers and catalyst solution in resin research.

The new "U" Pump Catalog, UP-52, gives full information on the "U" type pump plus extensive application data including specific service recommendations for handling over 300 substances. Write for your copy, today. HILLS-McCANNA CO., 2357 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of: Saunders Patent Diaphragm Valves Force Feed Lubricators • Magnesium Alloy Sand Castings

MUELLER

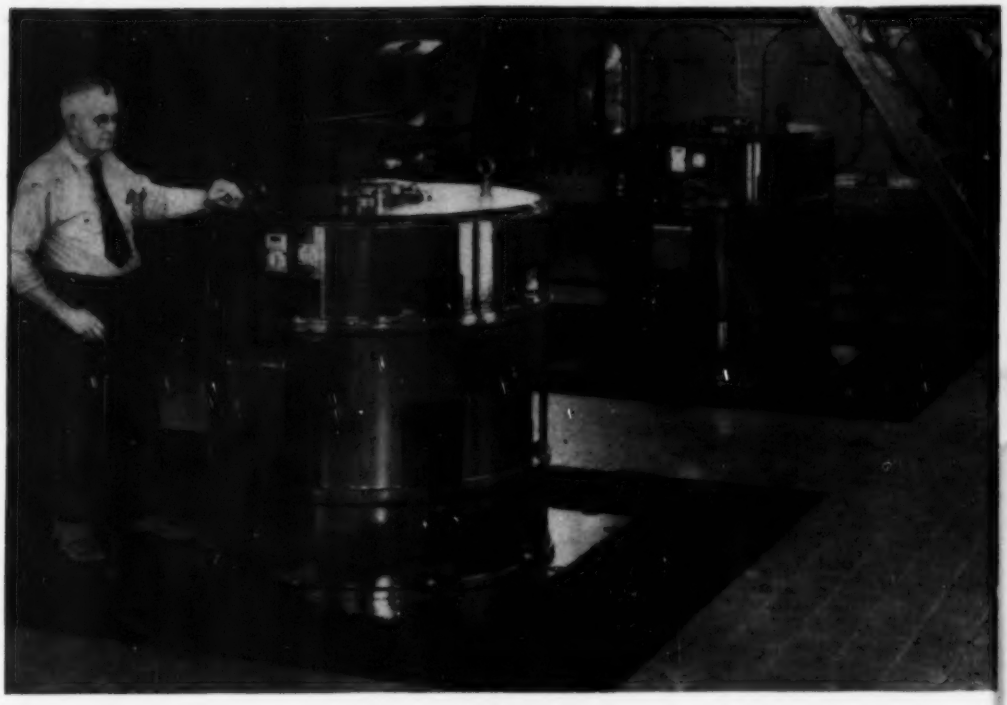
OUTSIDE METER SETTING — Moderate Climate
OUTSIDE METER SETTING — Cold Climate
COMPLETE
Meter Setting Equipment!
INSIDE METER SETTING
OUTSIDE METER SETTING — Moderate Climate

• COMPLETE *is* the word for Mueller Meter Setting Equipment . . . take your choice of a broad selection of vertical, straight line or angle type meter yokes . . . flat head or lock wing angle stops . . . test valves . . . meter couplings. Standardize on Mueller products for everything from main to meter — corporation and curb stops . . . service boxes . . . service pipe and connections . . . plus meter setting equipment. They're built to last . . . that means low maintenance costs. They're built to function properly . . . that means customer good will. For these reasons MUELLER has meant *quality* to Water Works men for almost a century! Call your Mueller representative or write for additional information.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS



10 AND 11 FOR FLINT

Twenty-five years ago, the city of Flint, Michigan, purchased the original motors for its Third Avenue Sewage Pumping Station from E-M.

In 1948, the city bought six additional motors from E-M, totaling over 2,500 hp.

This year, Flint installed two more E-M motors — the 400 hp, 585 rpm vertical induction motors shown above to drive sewage pumps.

These repeat orders for eleven motors, based on years of experience with the product, are the most convincing proof we know of the reliability and economical operation of E-M motors. A customer has to be thoroughly pleased to place his *third* order!

Flint's new E-M motors offer premium efficiencies and reliability for tough, round-the-clock drives. They're protected against moisture and corrosive fumes by special insulation. And their simple, rugged construction is easy to adapt to vertical drives.

When you need power for the biggest, toughest pumping jobs, you can rely on E-M induction and synchronous motors . . . because they're specially designed for your particular needs, by E-M specialists in big motor engineering.

Call your nearest E-M field engineer for his suggestions on your specific requirements, and write to the factory for Pump Bulletin No. 33.

ELECTRIC MACHINERY MFG. COMPANY

MINNEAPOLIS 13, MINNESOTA

1300-TPA-2126

SPECIALISTS IN *Big Motor* ENGINEERING

(Continued from page 101A)

Marvin Lane has been advanced to the position of Technical Manager. Mr. Lane has specialized for many years in water conditioning laboratory, pilot plant, field experimental and plant operating work, and has been the company's Chief Chemist since 1949. In his new capacity, his responsibilities will include design development, process standards and guarantees, water treatment recommendations, and analysis of installation performance.

The company's Customer-Service Department will be in charge of William J. Lewis, who has had considerable research, field engineering, plant operation and installation servicing experience in water conditioning equipment since his graduation as B.S. in Chem. Eng. from Kansas State College in 1937.

Nickel Plated Pipe Now Available in Small Sizes

905

Bart Manufacturing Corp., Belleville, N.J., has announced that Bart Lectro-Clad tubing can be produced in sizes smaller than 1½ inches. This is accomplished by depositing adherent film of pure nickel on 1½ inch or larger tubing or pipe which is then cold reduced to desired size.

According to the company, a 2⅛ inch o.d. tubing was reduced as described to 1-3/10 inches o.d. with continuous film of nickel on the inside diameter. Reduction of between 5 and 6 to 1 was successfully accomplished in one pass without intermediate annealing.

FOR WATER SOFTENING . . . TURBIDITY AND COLOR REMOVAL
. . . INDUSTRIAL WASTE TREATMENT . . .

The Clariflow

with independently-operated mixing, flocculation, stilling and sedimentation zones

The CLARIFLOW gives control over each individual function of controlled reaction stage flocculation, vertical clarification and positive slurry thickening and removal.

Initial mixing and reaction done in an isolated mixing tank insuring complete reactions.

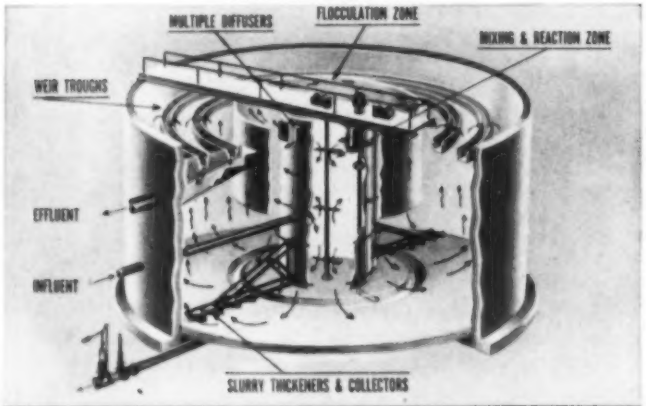
Exclusive multiple, tangential diffusers simultaneously and equally distribute flow to avoid "tendencies" and initiate slow flocculation.

Recirculation of precipitate for catalyzing purposes is positive and controllable. Erratic "Blanket Filtration" is not practiced.

Thickeners used to scrape settled slurry to the blow-off point.

Exclusive *Balanced* multiple surface weir troughs make efficient use of short detention periods and insure clarified overflows.

Write for Bulletin 656



WALKER PROCESS EQUIPMENT INC.
FACTORY • ENGINEERING OFFICES • LABORATORIES
AURORA, ILLINOIS
PROQUIP PROCESS EQUIPMENT

Worthington Appoints Watson Director of Research

Worthington Corporation, Harrison, N.J., has announced that Ralph M. Watson has been named Director of Research.

Mr. Watson graduated from the California Institute of Technology in 1928 with honors and a Masters degree in Mechanical Engineering. The following 9 years he served as engineer in municipal water works in California and as a graduate assistant in the California Institute of Technology.

He joined the Worthington organization in 1936 as an engineer in the refinery pumps section of the Centrifugal Pump Division. In 1942 he was made chief engineer of that division and in 1945 assistant to the Vice President in charge of Engineering.

New Electrical System for Water & Sewage Level Control

906

General Electric Company, Schenectady, N.Y., has announced a new electrical system for sewage and water level control and indication.

Called Thermasul, the new system can be used in wet wells, sumps, reservoirs, elevated tanks, standpipes, etc., and will control pump motors, pump motor speeds, and supervisory and alarm circuits.

Basically, the Thermasul element consists of a temperature-sensitive, sintered-sulphide compound around

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

which is wound a resistance heater; the whole assembly hermetically sealed in a stainless-steel tube. In air, resistance of the element is low because the heater keeps the level detector approximately 280°C above the ambient air temperature. When the detector is immersed in liquid, the heat is conducted away and the resistance of the element jumps up rapidly, operating a small remotely-located relay.

According to G-E engineers, the non-corrodible construction and self-cleaning characteristics of the new device make it exceptionally useful for unattended locations. Deposits do not normally adhere to the detecting element because of the high operating temperature. There are no moving parts to jam or bind, no electrodes to be shorted or otherwise fouled by deposits, and Thermasul is not adversely affected by greasy films or ice.

Neptune Appoints Isley

Neptune Meter Company, New York, N.Y., has announced that Mr. J. W. Isley, who for the past six years has been Office Manager of their Kansas City Office, will represent the company in the sale of water meters. At the present time, he will be assisting Mr. J. R. Barnes in the State of Iowa.

Prior to coming with Neptune, Mr. Isley saw 26 months service with the United States Navy.

Fourth Generation to Management Position with Fairbanks-Morse

Fairbanks, Morse & Co., Chicago, Ill., has announced that R. H. Morse III has been appointed General Manager of the company's Beloit, Wiscon-

(Continued on page 108A)

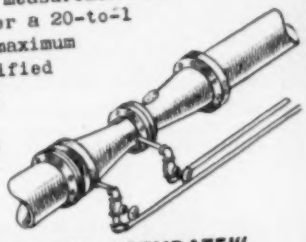
FLOW CONTROL NOTES FROM SIMPLEX

Metering Raw Sewage Under Pressure

Problem: to measure raw sewage prior to treatment, and at the point where it entered the plant. A survey showed that the sewage was flowing through a 24" line, under a head of about 20 feet of water. The sewage was both domestic and industrial and contained a high amount of suspended solids. Maximum flow was 24 MGD and minimum flow 1.3 MGD.

Solution: a 24" x 15.6" Simplex venturi tube was installed, including hand operated cleaning valves, clear water flushing devices, and pressure chambers at main and throat sections. A low head, indicating, recording and totalizing meter was furnished, along with a sediment tank in each connecting pressure line.

Result: accurate measurement was made possible over a 20-to-1 range, covering maximum and minimum specified flows. Cleaning valves and flushing devices kept the tube and tanks clear at all times.



"IT'S SIMPLEX—IT'S ACCURATE!"

SIMPLEX

VALVE AND METER COMPANY

SIMPLEX VALVE & METER COMPANY
6750 Upland Street
Philadelphia 42, Pennsylvania

Please send free Bulletin #401 entitled "Simplex Type 'H' Meter"

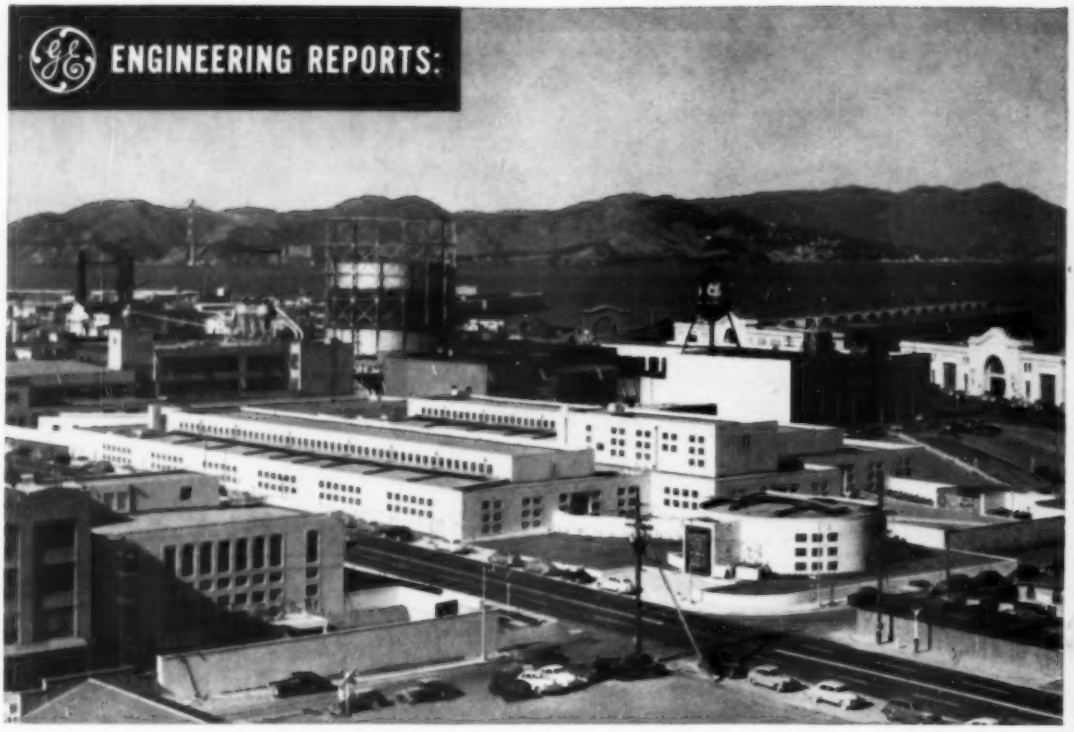
NAME _____

COMPANY _____

ADDRESS _____

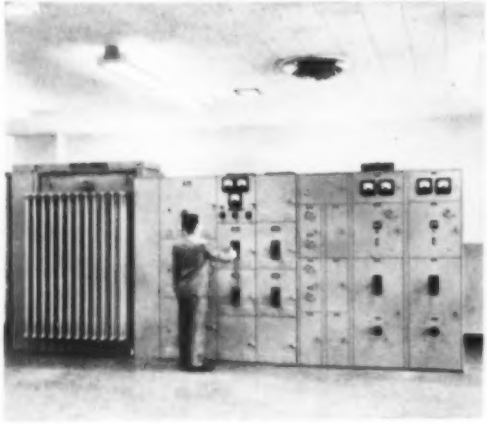
CITY _____ ZONE _____ STATE _____

GE ENGINEERING REPORTS:



1 COMPLETELY ENCLOSED OPERATION at San Francisco's North Point plant represents a modern trend in treatment-plant design. Attractive appearance and air purification make such a plant a good neighbor in any industrial area. M. & K. Corp., Stolte, Inc., Fred J. Early, Inc., and Haas & Rothschild acted jointly as general contractors for the plant. Electrical contractors were Pacific Electrical and Mechanical Co., Inc. and Del Monte Electric Co.

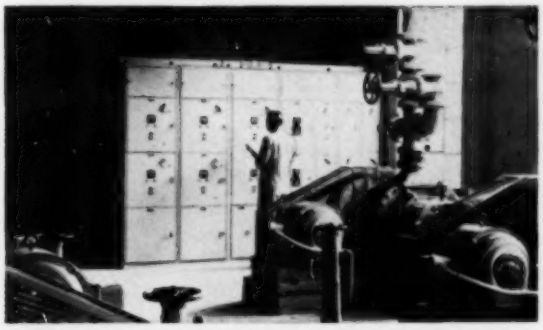
San Francisco continues its



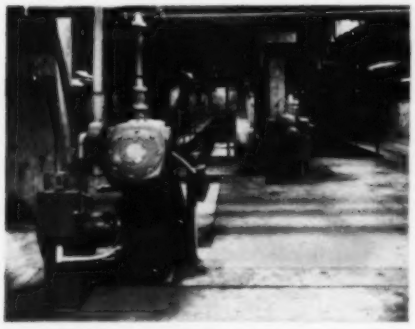
6 RELIABLE AND ECONOMICAL power distribution is provided by G-E load-center unit substation (with Cabinetrol) one of two which supply 480-volt power for small process motors.

7 MAIN CONTROL ROOM, completely G-E equipped, houses line-up of main plant switchgear and limitamp control. Field rheostats and exciters for lift-pump motors are at left.

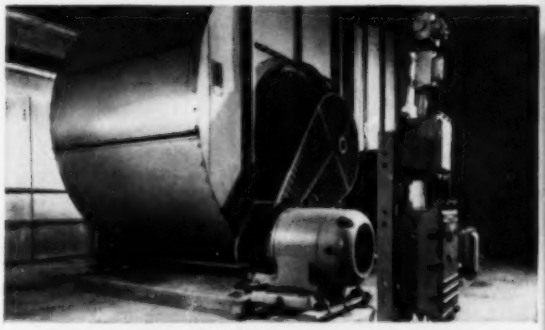
2 CHLORINE CONTROL PANEL, specially assembled by G.E., makes it easy to adjust output of plant's six chlorinators to match influent rate.



4 SIX BLOWERS, supplying all air for preaeration process, are each driven by a 40-hp G-E Tri-Clad* motor. G-E Cabinetrol* panel in background provides central control and protection of these motors.



3 IN PRE-TREATMENT and grit-removal building, small G-E totally enclosed motors drive sand collector and cross scraper, and grit-channel scraper.



5 EXHAUST FANS, driven by G-E totally-enclosed motors, are located in all buildings to prevent accumulation of nauseous and inflammable fumes. Air is treated with chlorophyll to kill odor before discharge.

CLEAN WATERS program

New North Point treatment plant is major step in plan permitting development of waterfront recreation areas

Recent opening of San Francisco's new North Point Sewage Treatment Plant marks the completion of the largest single unit in a planned 21-plant pollution control system for the city. According to City Engineer Ralph G. Wadsworth, the new 150-mgd plant, in conjunction with others, will make possible the development of safe, attractive bathing and boating areas and will result in general improvement of the entire waterfront.

San Francisco chose efficient, long-life General Electric equipment for a large part of North Point's electrical system. In addition, G-E application engineers worked closely with city engineers to help design an electrical system exactly tailored to the requirements of the new plant.

Specialists in sewage-plant electrification, G-E application engineers are ready to work with *your* engineers or consultants, too. Backed by unexcelled engineering facilities, they'll help in designing a coordinated electrical system for your new plant or modernization project. Contact your local G-E Apparatus Sales Office early in the planning stage. General Electric Company, Schenectady 5, N. Y. 666-73

*Registered trade-mark of General Electric Company

Engineered Electrical Systems for Sewage Plants

GENERAL ELECTRIC

(Continued from page 105A)

sin, works. This marks the fourth generation of the Morse family to come to the management staff of the company.

R. H. Morse III succeeds Orren S. Leslie as General Manager of the company's largest manufacturing plant. Mr. Leslie has been named Manager of Manufacturing and has been transferred to the company's headquarters in Chicago.

Mr. Morse, who will now direct all phases of operation at Beloit, was graduated from Princeton University with a degree in Mechanical Engineering. During World War II he served in the Navy for three and one-half years as a naval officer. He began his career with the company at the Beloit plant in 1946 and served in the interim in many capacities.

Phenolic Resin Coatings for Corrosion Resistance

907

Ric-wil Plastic Coating & Mfg. Corp., Cleveland, Ohio, has developed a line of "Ricwilite" Phenolic Resin Coatings.

Formulated to protect equipment against extremely corrosive conditions Ricwilite coatings provide a tough, impervious film which is resistant to attack by corrosive acids and alkalis, salt water, rust, raw sewage, and weathering.

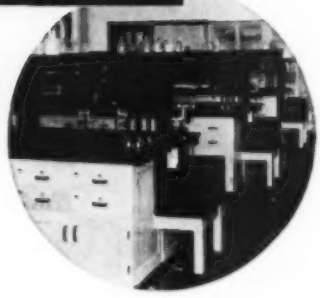
Ricwilite 1060 is of the baking or heat-hardening type. Ricwilite 7100 is of the cold-setting type which is cured or polymerized at room temperatures by the addition of a catalyst just prior to application. It can be applied to almost all metals, concrete, wood, and plaster surfaces by brush or spray.

Sturdy Oak

the STEEL of woods...

in all its natural beauty

For *your* laboratory—famous Kewaunee custom quality furniture in beautiful, long-lasting, natural finish oak. Oak—the *steel* of woods—for rugged service, long life. Oak—in natural finish—to brighten your laboratory, speed your work.



Specify oak—readily available—for durability and attractiveness. Specify Kewaunee—for finest custom quality, at extremely modest cost. Write today for a free copy of our catalog of Scientific Laboratory Equipment.

Representatives and sales offices in principal cities

Kewaunee Mfg. Co.

J. A. Campbell, President

3102 S. Center Street • Adrian, Michigan

Manufacturers of Wood and Metal Laboratory Equipment

Automatic Acetylene-Air Gas Torch

908

Velocity Power Tool Company, Pittsburgh, Pa., has developed a new automatic acetylene-air gas torch.

The pistol-shaped "Torch-O-Matic" lights at squeeze of trigger and shuts off upon release, eliminating separate operation and equipment for relighting, manual valve adjustment, pumping or priming, and warm-up.

Squeezing the spring-loaded trigger simultaneously opens the torch gas valve and sparks the heavy-duty flint for ignition. Trigger can also be cocked open for continuous flame.

The "Torch-O-Matic", only 12 ounces in weight, provides instantaneous heat up to 2800 degrees. Combustion tubes are available in three sizes, ⅛ inch, 3/16 inch, and ¼ inch.

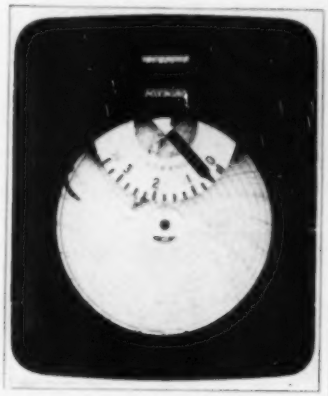
Jewell Elected President National Clay Pipe Research Assn.

National Sewer Pipe Company Limited, Toronto, Canada has announced that H. William Jewell, Chief of Research and Development,

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

has been elected president of the National Clay Pipe Research Association.

Mr. Jewell is a graduate of Finlay Engineering College and attended both Iowa State College and the University of Kansas. He was associated for many years with Pacific Clay Products of California before coming to Canada two years ago.



Automatic Control for Fluorine Feeder

909

The Foxboro Company, Foxboro, Mass., has announced the Foxboro Type 24-10 Controller for automatically maintaining fluorine feed rates.

The system consists of a solution feed or dry feed machine equipped with the controller. As the rate of water flow varies with consumer demand, the instrument causes the motor of the feeder to operate proportionally, permitting the correct amount of fluoride to be added automatically to the water supply.

The controller can be connected to the feeder motor directly or through relays. Installation requires only simple piping and wiring. The controller may be provided with integrating, indicating and recording features in any desired combination.

Portable Power Pipe Threader

910

Thread-Ezy Mfg. Co., Corunna, Mich., has developed the Port-A-Pony portable power pipe threader.

Weighing only 26 pounds, the Port-A-Pony utilizes the ring gear principle to turn dies at the most efficient cutting speed required to thread ¼ to 4 inch pipe. All popular types of hand die stocks are adaptable to the threader and dies can be seated and locked in place in a matter of seconds.

High Service Pump Room, Evanston, Illinois Water Works

climax BLUE STREAK ENGINES

Staying Power
FOR STANDBY SERVICE

Climax Blue Streak Engines drive generators and pumps in standby service, or furnish continuous power where natural or by-product gas is available in municipal water works plants.

For water works service Climax Blue Streak Engines are the choice because of their low upkeep expense, extra quick starting and sufficient surplus capacity to supply power for an indefinite period of time.

Two Climax 12 cylinder, 6½ x 7, 425 H.P. Gasoline Engines Direct Connected to 10 MOD Pumps for Standby Service in Evanston Water Works.

Write for complete information and specifications on these dependable power plants. There are 4, 6, 8 and 12 cylinder engines, rated from 40 to 600 H.P., operating on natural gas, Butane or gasoline. Sewage gas engines are available in sizes 50 to 250 H.P.

climax

ENGINE AND PUMP MFG. CO.

Factory and General Office Clinton, Iowa

Regional Offices Chicago - Dallas

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

The Port-A-Pony is attached to the pipe in the same manner as a hand operated pipe threader and is powered by a ½ h.p. 110 volt AC or DC reversible electric motor.

Builders-Omega Open Kansas City Office

Builders-Providence, Inc., and Omega Machine Co., Providence, R.I., has announced the opening of company offices in Kansas City, Mo.

The new office will be located at Room 207, Congress Bldg., 3527 Broadway, Kansas City, Mo., and will bring increased Engineering and Maintenance service to local customers and Consulting Engineers throughout the Missouri-Kansas area.

Ray W. Lindsey will head the new Mid-West office as Sales Manager. Mr. Lindsey has previously been a Sales Engineer in the Chicago Office of Builders and Omega. A graduate Civil Engineer from the University of Minnesota, he was formerly associated with the firm of Hitchcock and Estabrook, Cons. Engrs., in Minneapolis, where he gained a broad experience in the design and construction of municipal water and sewage plants.

LEOPOLD
Glazed Fire Clay
TILE FILTER BOTTOMS

Successfully serving over 200 PLANTS with a daily capacity of over THREE-QUARTER BILLION GALLONS

Check THESE LEOPOLD FEATURES:

Permanent · No corrosion or tuberculation · Economical · Equal distribution · Uniform filtration · Low loss of head · No large size gravel required · Proved superiority · No metal in contact with water!

PARTIAL LIST OF MUNICIPAL INSTALLATIONS

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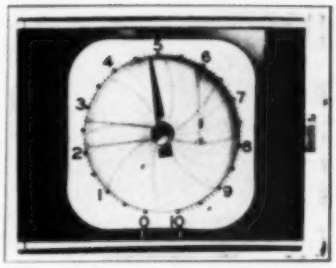
Phoenix, Ariz.
Little Rock, Ark.
Trinidad, Col.
Washington, D.C.
Fort Lauderdale, Fla.
Evanston, Ill.
Indianapolis, Ind.
Council Bluffs, Iowa
Kansas City, Kansas
Topeka, Kansas
Owensboro, Ky.
Shreveport, La.
Monroe, Mich.
Columbia, Mississippi
North Kansas City, Mo.
Billings, Montana
Lincoln, Neb.
Lima, Ohio
Bartlesville, Okla.
Eugene, Oregon
Philadelphia, Pa.
Allentown, Pa.
Memphis, Tenn.
Fort Worth, Texas
Port Arthur, Texas
Wichita Falls, Texas
Norfolk, Va.
Wheeling, W. Va.
Menasha, Wis.
Worland, Wyo.
Passaic Valley Water Commission, Little Falls, N.J.

F. B. LEOPOLD CO., INC.
2413 W. CARSON ST., PITTSBURGH 4, PA.
COMPLETE WATER PURIFICATION and SEWAGE PLANT EQUIPMENT
DRY CHEMICAL FEEDERS · FILTER OPERATING TABLES · MIXING EQUIPMENT



Round-Chart Recorder Added to Bristol's Dynamaster Line

911

The Bristol Company, Waterbury, Conn., has announced the addition of round-chart recorders and automatic controllers to its line of electronic Dynamaster potentiometers and bridge instruments.

The new round-chart electronic instruments can be used to measure any variable that can be translated into an electrical quantity. Typical sensing elements that can be used with the new Dynamaster instruments include thermocouples, resistance thermometer bulbs, pH amplifiers, strain gauges, etc.

The measured variable is simultaneously recorded on a 12-inch diameter chart and indicated on a large circular scale which is legible at a distance. Models are offered for full-scale pen travel in 7 seconds, 3 seconds, 1½ seconds, or 2/3 seconds, and with a wide variety of ranges.

Dresser Appoints Mattern Waterworks Sales Representative

Dresser Manufacturing Division, Dresser Industries, Inc., Bradford, Pa., has announced the appointment of Mr. James L. Mattern as Waterworks Sales Representative for the Central and Western part of Pennsylvania and New York states and all of Ohio. Mr. Mattern will specialize in Jobber and Waterworks accounts throughout his territory.

Originally from Phillipsburg, Pennsylvania, Mr. Mattern joined Dresser in August of 1951. Prior to his recent appointment, he served five

(Continued on page 112A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

CORROSION affects every Water and Sewage Project

MILLIONS OF DOLLARS ARE LOST ANNUALLY

Your Hard-to-Get Equipment

. . . may be ruined by constant attack of acids, fumes, chemicals, moisture, gases and weathering.

Expensive Shutdowns

. . . and reduced capacity with costly man-hours for repairs may be incurred unnecessarily.

Your Efficiency

Ruined equipment, the loss of capacity, and repair expenses caused by shutdown mean only one thing . . . increases in operating costs.

RIGHT NOW . . . you should investigate the economies of using Amercoat; a *line* of coatings built to protect against *specific* industrial corrosion hazards.

Our field engineers are available . . . without obligation . . . to check your plant for corrosion problems . . . and to give you *specific* recommendations.

AMERCOAT CORPORATION

(Continued from page 110A)

years in the U. S. Army and was discharged with the rank of Captain of the Air Force.

Anderson Appointed Advertising Manager for Dearborn Chemical

Dearborn Chemical Company, Chicago, Illinois, has announced the appointment of Mr. Robert R. Anderson as Advertising Manager.

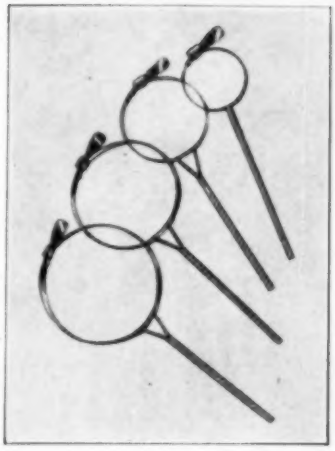
Mr. Anderson was formerly with the Advertising Staff of Fairbanks, Morse & Co. This appointment fills a vacancy created by the resignation of Mr. Earl J. Goris who left Dearborn to accept a position with W. H. Male, Ltd. of Honolulu, T.H.

Irwin Made Ass't. Sales Manager for U. S. Pipe

United States Pipe and Foundry Company, Burlington, N.J., has announced the appointment of Thomas B. Irwin, formerly Kansas City sales agent, as assistant western sales manager with headquarters at Chicago.

Bartlett G. Bretz, formerly sales representative at Kansas City, has been appointed Kansas City sales agent.

MH
DOUBLE SQUARE BOTTOM
GATE VALVES
When it is desired to install a gate valve for throttling purposes, or in a vertical pipe line, M & H double square bottom valves have many important advantages.
When valve is opened, each of the three shoes on both discs immediately contact the feathered edge of the tracks. These three contacts result in the disc being eased away instantly from the seat. The shoes then ride the tracks squarely and firmly for the full travel of the disc. In closing, discs ride the tracks down to a point exactly opposite the valve seat. At that point, the discs are clear and free to seat by action of the two spreaders, each functioning independently of the other.
M & H double square bottom valve prevents the down stream gate from tilting into the down stream port opening and by chatter or vibration damaging the seat and gate rings. These valves can be installed with either disc on the down stream side.
Available in classes A, B, and C, sizes 3" and larger. Where needed, can be supplied with rollers; or roller, tracks and scrapers. For complete information, write or wire M & H Valve and Fittings Company, Anniston, Alabama.
M&H PRODUCTS
FOR WATER WORKS • FILTER PLANTS
INDUSTRY • SEWAGE DISPOSAL AND
FIRE PROTECTION



Varigrip Clamps Hold Cylindrical Glassware Safely

912

Labline, Inc., Chicago, Illinois, has developed the Labline Varigrip Clamp for holding beakers, Dewar flasks, vacuum vessels, etc.

The Varigrip is always rigid—employs no chains or other awkward accessories and is quickly and easily adjusted with a large flat thumb screw. A combination handle and clamp, its use removes hazards when pouring or handling beakers containing hot or dangerous liquids.

Thomas Cruthers is Dead

Worthington Vice President in Charge of Water Treatment Division

Thomas Cruthers, Vice President of Worthington Corporation since 1936, passed on at his West Orange, N. J. home on July 27th.

Mr. Cruthers, who graduated from Stevens Institute of Technology, joined the Worthington organization in 1907 in charge of the Gas Engine Field Erection Department. From 1925 to 1929 he held successive positions of sales engineer, assistant sales manager and sales manager in the New York office. From 1930 to

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

1932 he was assistant general sales manager and from 1932 to 1936 assistant vice president in the general sales department. Sales Divisions, headed by Mr. Cruthers, included Water Treatment, Public Works, Steam Power, and Steam Turbine.

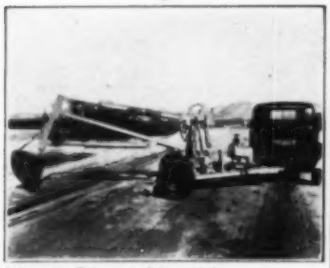
He was a member of the board of governors of the National Electrical Manufacturers Association, a director of the N. J. State Chamber of Commerce, and a member of the Society of Naval Architects and Marine Engineers, American Society of Refrigeration Engineers, National Association of Manufacturers and the Heat Exchange Institute. He was also a member of the N. Y. Railroad Club, the Traffic Club of New York, Montclair Golf Club, and the Essex Club of Newark.

John Hassey Joins Neptune

Neptune Meter Company, New York, N.Y., has announced that John Thomas Hassey has joined its sales force. He will represent the company in the sale of water meters in the New England Territory, assisting Mr. Charles W. Krause, with headquarters at Boston.

Mr. Hassey is a graduate of Massachusetts Institute of Technology, majoring in Business and Engineering Administration.

He served with the Marines during World War II and just recently completed 18 months more of active service as a Reserve Officer with the rank of Captain.



Hopto Digger Now Has Independent Power Source

913

Badger Machine Company, Winona, Minn., has announced that the

BETTER BE SAFE THAN SORRY WHEN YOU'RE MOVING GAS OR AIR

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
- ☐ Ruggedness
- ☐ Ease of installation
- ☐ Ability to handle overloads
- ☐ Long-time durability
- ☐ Freedom from breakdowns
- ☐ Low maintenance costs
- ☐ Engineering assistance
- ☐ Proved reputation of maker
- ☐ Customer satisfaction

Battery of four 3-Stage Centrifugal Blowers in metropolitan sewage treatment plant. Capacity of each, 15,000 cfm.

You can't afford to take chances when the successful operation of a sewage treatment plant depends upon maintained performance of blowers or gas pumps. So, we suggest that you check carefully the above factors before you make your final decision.

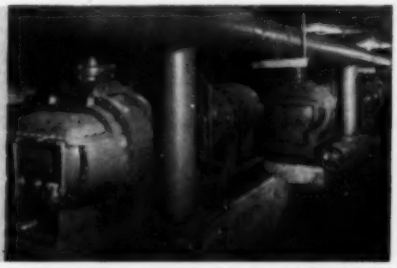
If you are faced with a choice between Centrifugals or Rotary Positives, remember that only Roots-Connersville makes both types. From our exclusive *dual-ability line*, with capacities from 100 cfm to 100,000 cfm or higher, at moderate pressures, most buyers can find a unit closely matched to their specific needs.

We'd like to remind you, too, that for almost a century we've built only blowers and related equipment. Our products have a long, happy record for outstanding, reliable, economical performance in large and small sewage treatment plants and waterworks. Our vast reservoir of experience is at your service, to meet any problem of handling gas or air.

ROOTS-CONNERSVILLE BLOWER CORPORATION
524 Mount Avenue, Connersville, Indiana

ROTARY

In the plant illustrated above, three R-C Gas Pumps are used for boosting pressure from gas storage to engines.



Reg. U. S. Pat. Off.

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

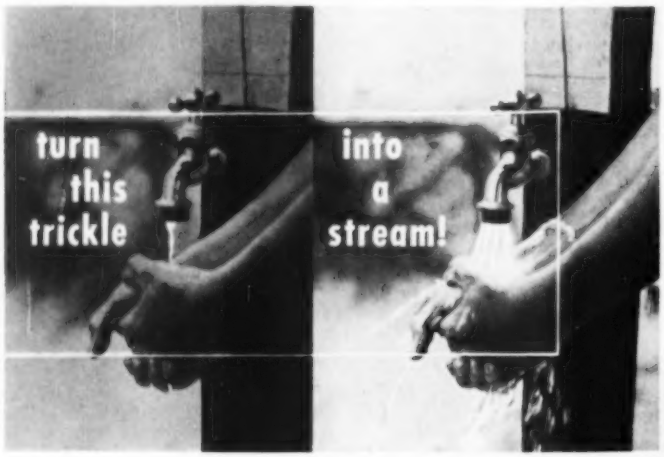
Hopto Digger, trailer mounted, comes with its own power source.

The digger is powered with a Wisconsin VF4 air cooled motor with 2.1 reduction. It will trench 60 feet hourly to a depth of 6 feet in average soils. When used for excavating it will move 45 yards per hour with a 24 inch bucket.

Engineering and Service Manager Named by Worthington

Worthington Corporation, Harrison, N.J., has announced the appointment of F. E. Peltier as Manager of Central Regional Engineering and Service, with offices in Cleveland. Peltier will supervise the engineering and service in the company's district office territories of Detroit, Cleveland, Cincinnati, Buffalo and Pittsburgh.

Following his graduation from Case Institute of Technology in 1940, with a B.S. degree in civil engineering, he took Worthington's student engineering course. For the next seven years he served as a project engineer in the company's Research and Development Department. Since 1949 he has been an application engineer on high pressure hydraulic systems in the centrifugal and reciprocating pump divisions.



If loss of pressure is your water problem, the source of trouble may be tuberculation and corrosion in your pipelines. In this case the Centriline process can turn this trickle into a stream . . . and can put smiles back on the faces of the taxpayers of your community.

Centrilining is the application of cement mortar to the walls of pipelines in place, after cleaning. At a fraction of the cost and trouble of replacement, Centrilining extends the life of old pipes *indefinitely*. For complete information on this time proven process, write for your free copy of Centriline's new booklet.

Pipelines 4" to 14" are cement-lined by the Tate Process.

CEMENT-MORTAR LININGS FOR PIPES IN PLACE

2,500,000 FEET OF EXPERIENCE

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET, NEW YORK 6, N. Y.

Branch Offices in Principal Cities of United States and Latin America

ON THE WEST COAST, WRITE PIPE LININGS, INC., P. O. BOX 3428, TERMINAL ANNEX, LOS ANGELES, CALIFORNIA

Beckman's Special Division for Instrument Development

Beckman Instruments, Inc., South Pasadena, Calif., has announced the establishment of a new Special Products Division, under the direction of Mr. J. F. Bishop. The new division will be devoted primarily to the study and development of special instruments brought to it.

Beckman Special Products Division is a completely separate organization within the Beckman Instrument operations, and is located in its own modern plant, with complete development and production facilities particularly designed for the manufacturing and testing of custom-built instruments.

Fisher Develops Improved Titrimeter

914

Fisher Scientific Co., Pittsburgh, Pa., has announced a new improved Titrimeter, that was designed after a comprehensive study of thousands of Fisher Titrimeters in present use.

The new Titrimeter features a completely new stand; improved stirrer and control box; and integral provisions for micro-titrations and Karl Fischer moisture determinations.

The new stand is a massive, functional casting that firmly supports the burettes and sample beaker, so that they are close to the magnetic stirrer, electrodes, and "magic eye" end-point

(Continued on page 115A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

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WATER & SEWAGE WORKS

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WATER & SEWAGE WORKS READER SERVICE

READER SERVICE CARDS HOW TO USE THEM

Please fill out a separate coupon for each item on which you desire information. This will greatly facilitate handling.

Key number is at head of each new product, item of equipment, catalog or bulletin, described in this issue.

Enter key number in box.

Please PRINT your name and title, company or department name, and your address

NOTE—

These cards are to be used only for items described in THIS ISSUE

WATER & SEWAGE WORKS

Will see that you receive information desired.

(Continued from page 114A)

indicator. It has a hood to protect all connections from "hand capacity" effects.

All belts, shafts and stirring electrodes have been eliminated and in their place are magnetic stirrers and fixed electrodes.

A calibrated dial and two simple controls are the only manipulative parts on the new control case. The scale on the dial is graduated in pH units as well as volts.

Eversharp Likes Recently Acquired Climax Engine Co.

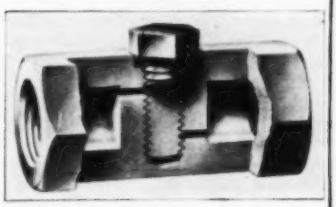
In reporting to the stockholders and the Board, Carl G. Preis, President of Eversharp Inc., (razors, pens, pencils, and now pumps and gas engines) had the following to say about Eversharp's recently acquired Climax Engine & Pump Mfg. Co.

"It is a far jump from the razor and pen field to gas engines (that operate on by-product gas from municipal sewage, as well as natural gas), but Climax is a well-contained unit, and on the basis of results obtained so far, it will add substantially to operations and earnings of Eversharp, Inc."

Dravo Appoints Oesterle Sales Manager

Dravo Corporation, Pittsburgh, Pa., has announced the appointment of Paul D. Oesterle as Sales Manager of the Piping Department.

Mr. Oesterle is a graduate of University of Pennsylvania with a B.S. Degree in Mechanical Engineering. He joined Dravo in 1941.



Air Flow Snubber and Pulsation Damper

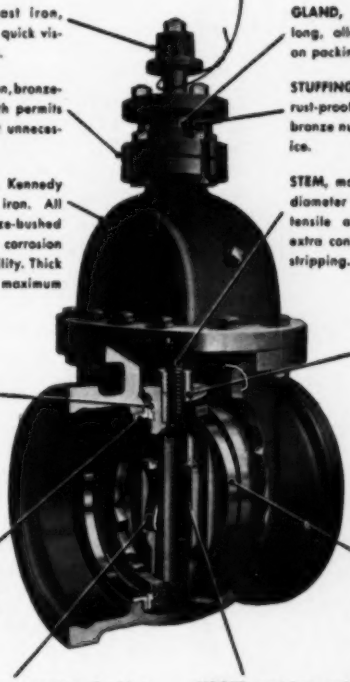
915

King Engineering Corp., Ann Arbor, Mich., has developed a new air flow snubber and pulsation damper.

This unit provides a controlled slow rate of flow of compressed air or gas for operation of continuous-reading hydrostatic instruments and for purging pneumatic instrument lines. It also protects pneumatic test-

Dependable Performance is designed *into* this KENNEDY Valve

KENNEDY IRON BODY DOUBLE DISC GATE VALVE
FIG. 56, 16 in. A.W.W.A. Standard, bell-end, non-rising stem. Working pressure: 3 in. thru 60 in.; water, 150 lb. per sq. in.



OPERATING NUT, cast iron, large, well-marked for quick visual check of operation.

STUFFING BOX, cast iron, bronze-bushed, generous depth permits ample packing without unnecessary tightness.

BONNET (and body), Kennedy Higher-Strength cast iron. All bearing surfaces bronze-bushed or bronze-faced for corrosion resistance, extra durability. Thick metal throughout for maximum strength.

DISC RINGS, bronze, each with accurately formed tongue forced into dovetailed groove in disc under heavy pressure for solid, leakproof joint.

SEAT RINGS, heavy bronze, threaded and screwed into body, removable, interchangeable, easily replaced when necessary.

WEDGES, bronze, interchangeable. Combination of bronze wedges, bronze seats, cast iron hooks prevents corrosion trouble in mechanism.

GLAND, bronze-bushed, extra long, allows maximum take-up on packing.

STUFFING BOX BOLTS, tee-head, rust-proofed steel, with durable bronze nuts, give long-lived service.

STEM, manganese bronze, large diameter with exceptionally high tensile and torsional strength, extra contact threads to prevent stripping.

STEM NUT, manganese bronze, operates independently, prevents stem from binding, springing or bending... fits into disc tops and releases one before the other to prevent sticking or locking on opening.

DISCS, Kennedy Higher-Strength cast iron, with bronze wedge seats, discs deeply ribbed to eliminate distortion.

HOOKS, cast iron, extremely heavy, arrested by steps at bottom of valve body, hold wedges stationary to force discs tight against valve seat.

WRITE FOR BULLETIN 106

THE **KENNEDY**
VALVE MFG. CO. • ELMIRA, N.Y.
Est. 1877
VALVES • PIPE FITTINGS • FIRE HYDRANTS

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

ing and gaging equipment against damage that might result from surge pressures, by providing a flow restriction in the line.

The snubber is also used as a pulsation damper for pressure gages, recorders, manometers, and similar instruments.

Syntron Opens New Chicago Store

Syntron Company, Homer City, Pa., has announced that The Syntron Chicago Sales Company has opened a new store at 236 N. Crawford Avenue, Chicago, Illinois.

In addition to increased facilities for the engineering and sales staff, the new location affords ample room for carrying stocks of equipment and providing local service on Syntron Power Tools.

Link-Belt Appoints Two Chief Engineers

Link-Belt Company, Chicago, Ill., has announced the appointment of Robert W. Suman as chief engineer for the new Colmar, Pa., plant and Norman Virkler to succeed Mr. Suman as chief engineer for the Philadelphia plant.

Mr. Suman joined Link-Belt in 1934, on graduation from Armour Institute of Technology. He served at the Link-Belt Caldwell plant in Chicago before becoming chief engineer for the Philadelphia plant.

Mr. Virkler has been associated with the Link-Belt Philadelphia plant almost 35 years, joining the company in 1917. Since 1946 he has been in charge of all enclosed drive development work. He also handled development and standardization of sanitary engineering equipment.

Four Tapping Collars Cast Integral On Each 18' Length

McWANE 2" & 2¼" THREADED CAST IRON PIPE

UNTRAINED WORKMEN JUST SCREW IT TOGETHER!

Small Diameter Cast Iron Pipe has been one of McWane's outstanding developments. Today, McWane is nationally recognized as the leader in the manufacture of Cast Iron Pipe with 2" and 2¼" inside diameters. Different types joint are available for this small diameter pipe. One of the most popular of these is McWane's Oversize Threaded Joint. Both McWane 2" and McWane 2¼" pipe have 2½" oversize male-and-female threads—as shown in the cut-away illustration above.

Laying McWane Threaded Pipe is a "pipe dream." One man by himself easily screws together 18' sections alongside the trench or on skids laid across the trench. The line then is "snaked" into the trench, tested and covered up. That's all there is to it! For complete information, write McWANE CAST IRON PIPE COMPANY, BIRMINGHAM, ALABAMA.

McWANE PIPE Lasts for Centuries

Universal Nipple Chuck For Threading Pipe

916

Beaver Pipe Tools, Inc., Warren, Ohio, has introduced a Universal Nipple Chuck capable of threading ⅛-inch to 2-inch pipe.

This new Universal Nipple Chuck has but three parts—a polished steel body, a sliding plunger and a hardened steel threading shank. Nipples are easily removed by hand, no wrenches are required.

Adapters allow for all sizes from ⅛ to 1½ inch pipe. No adapter is needed for 2-inch pipe. An inserted pin retains the sliding plunger in working position.

Usable four ways . . . with a pipe machine, a power drive, any pipe vise or machinist's vise, the Beaver "55" Universal Nipple Chuck converts short lengths of pipe into useful all-thread, close-thread or average nipples. Optional equipment includes a heavy gauge sheet metal kit box for carrying chuck and a full range of adapters.

Dorr Company Assignments in Foreign Fields

The Dorr Company, Stamford, Conn., has announced that Mr. Neil Munro has arrived in Bombay, India, to assume the responsibilities of Managing Director of Dorr Oliver (India) Ltd., upon the departure of Mr. P. M. Contant, who is return-

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ing to the United States on leave. After spending about two months in Europe, Mr. Contant will be located at the company's offices in Stamford, Conn., for an indefinite period.

Mr. Harry Judson, formerly of the Central Industrial Division of North American Sales has been transferred to International Sales and has relieved Mr. Munro as Technical Representative in Johannesburg, South Africa, located with E. L. Bateman, Ltd., who have been representatives of The Dorr Company for over 20 years.

Pre-Fabricated Units Solve Drainage Problems

917

Standard Foundry Products, New York, N.Y., is offering a universally applicable method of effective drainage control, by means of standard "Drain-Master" units.

The basis of this system is the "Drain-Master" unit, which consists of a center piece (or receptacle), a top grating, and 2 end pieces. Assembled "Drain-Master" units fit together in slip-joint manner. Thus, any desired length of drainage installation is possible.

The parts are cast of heavy duty iron and will sustain heavy loads. Three basic standard sizes are available: 13 x 9¾ x 4¼ inches deep, 6¼ inches deep and 8¼ inches deep.

Bridgeport Brass Appoints New Sales Executives

Bridgeport Brass Company, Bridgeport, Conn., has appointed Mr. Chester M. Adams as general Sales Manager to direct the sales of all of their products.

Mr. George H. Baldwin, formerly Sales Manager, Mill Products, has been made Assistant General Sales Manager and Mr. Richard L. Allen

FILER & STOWELL SLUICE GATES

are built to stand long trouble free service. Amply proportioned for all stresses of shipment, erection and operation. They may be obtained with manual, hydraulic cylinder or motor operating controls.

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MILWAUKEE 7, WISC.

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LEAKAGE
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CARSON CLAMPS
With Charcoal Cast Iron Bolts for Cast Iron Pipe and Fittings.
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Wilkes-Barre, Pa.
All correspondence regarding sales and engineering should be addressed to:
PALMER FILTER EQUIPMENT CO.
822 E. 8th St. Erie, Pa.
Engineers and Sales Agents

has been appointed as their Sales Manager of Mill Products for both the Bridgeport, Conn. and Indianapolis, Ind. plants of the company.

Belco Builds New Plant

Belco Industrial Equipment Division, Inc., Paterson, N.J., has announced the construction of a new plant which will provide additional manufacturing facilities and will also house the general offices and engineering departments.

According to Robert Herwig, Belco Vice President and General Manager, the new plant will provide 25,000 additional feet of floor space. Completion of the new structure is scheduled for July of this year. The new plant is located on Pennsylvania Avenue in Paterson adjoining plant No. 1 of the parent company, the Bogue Electric Manufacturing Company.

Cold Galvanizing Process

918

Galvanite Corp., New York, N.Y., has announced the availability of Galvanite, a cold galvanizing compound.

The company states that Galvanite is not a paint, but actually a cold galvanizing compound, and in many cases outperforms other surface protection techniques including electroplating, hot dipping, cementation, spraying and painting.

Galvanite may be applied with any ordinary paint brush, electric spray gun or by cold dip.

According to the company, one of the tests made was on bright and rusty steel treated with galvanite and submerged in salt water for two years. Scratch tests showed both samples to be free of any loose rust after their long immersion period.

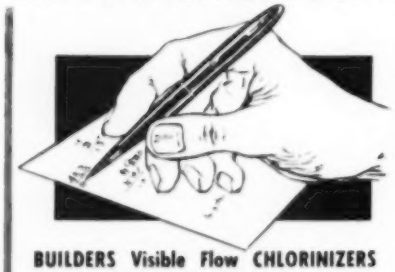
HOW DO **YOU** FIGURE YOUR CHLORINATING COSTS?

A. Naturally you figure the cost of the chlorine itself.

B. Then you add to this depreciation and interest on your investment in chlorinating equipment.

C. Next there's the cost of personnel required to operate your chlorinating program.

D. And last but not least, you consider the cost of maintaining your chlorinating equipment in safe, efficient operating condition.



BUILDERS Visible Flow CHLORINIZERS give you the most for your chlorinating dollar because they influence every factor of the cost equation.

A. Because Chlorinizers incorporate a true flow meter and an ultra-dependable chlorine flow regulating system, these chlorine gas feeders allow you to maintain the exact chlorine feed you require without danger of under dosage . . . and without need of costly over dosage. No auxiliary injectors bleeding chlorine to waste during shutdown of semi-automatic equipment.

B. Builders Chlorinizers are fairly priced as evidenced by the fact that they have been selected by cost-conscious municipalities and industrial plants throughout the country. Longer life reduces depreciation burden.

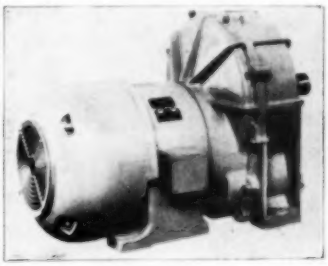
C. Builders Chlorinizers are built of simple, easy-to-understand mechanical components. Any competent mechanic can quickly master the operation of these modern chlorine gas feeders.

D. Builders Chlorinizers are maintenance misers. Every detail of their design and construction has been carefully worked out to eliminate costly day-to-day service and replacement.

☆ ☆ ☆

Yes, there's real economy in every Builders Chlorinizer. It will pay you to get facts and figures. Write for illustrated Bulletins. Builders-Providence, Inc. (Division of Builders Iron Foundry), 350 Harris Avenue, Providence 1, Rhode Island.

BUILDERS PROVIDENCE *Instruments*



Geared Electric Drive with Double Reduction Gears

919

Sterling Electric Motors, Inc., Los Angeles, Calif., has announced the addition of larger totally enclosed fan-cooled geared motors to the line of Slo-Speed electric power drives.

These new units are double reduction and available with Class I, II and III gears in frame size 364/365, and AGMA speed 155 rpm and slower in ratings from 5 to 25 hp.

In this drive bearings are mounted in the outer walls of the gear case and gears are mounted between these widely spaced bearings, permitting use of offset shafts and providing permanent bearing and gear alignment in uniform distribution of load.

Bruce Greaves Co. Represents Conoflow in St. Louis

Conoflow Corporation, Philadelphia, Pa., has appointed Bruce Greaves Co. to represent Cono Controls in the St. Louis Territory.

Specializing in instrumentation and industrial power equipment, the Company was founded in 1945 by Bruce Greaves, at that time an instrument engineer for a major chemical company. Last year James W. Bennett

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joined the firm, coming from a large instrument company in Philadelphia where he was General Sales Manager.

Located in St. Louis, the Bruce Greaves Co. will service the eastern part of Missouri and southwestern Illinois with Conoflow pneumatic control equipment.

Portable Diesel Engine Pyrometer

920

Bristol Company, Waterbury, Conn., has developed a new portable diesel engine pyrometer.

The new instrument is designed for test purposes and for installations where no permanently mounted pyrometer is available. The thermocouples can be installed in each cylinder and in the main exhaust line. Temperatures can then be checked at any time by inserting the pyrometer prongs into the corresponding receptacles in the terminal head of the thermocouple.

Literature & Catalogs

Waterworks Manual

921

Stuart Corporation, Baltimore, Md., has available a new **Stuart's Manual for Waterworks Engineers.**

The manual discusses in detail the Palmer Surface Wash Systems; Walking Beam Flocculating Equipment; Hapman Pipeline Conveyors; Leopold Filter Bottoms; Anthrafilt Filter Medium; and Jar Test Machines.

Photographs of actual installations as well as dimensional line drawings of all equipment are also included. A convenient series of conversion charts and tables complete the manual.

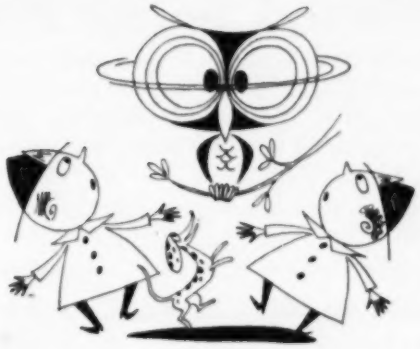
Wheel Trenchliner

922

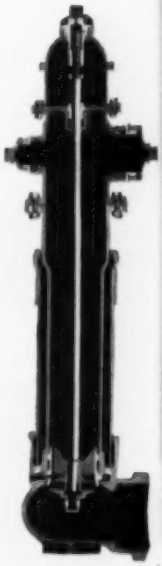
Parsons Company, Newton, Iowa, has just issued a colorful 4-page catalog describing the features of the new **Parsons Model 202 Trenchliner.**

According to the catalog, the new Trenchliner is full crawler mounted and is equipped with either square or round bottom buckets that cut trenches 13 to 31 inches wide, to a maximum depth of 6 feet. Its range of 30 digging feeds extends from 6.2 inches to 18½ feet per minute. Bucket fronts can be changed quick-

Head turns all the way around



Nozzle direction may be changed easily and at any time by simply loosening the bolts in the swivel flange and turning the head . . . The number and size of nozzle outlets can be changed by replacing the head, and without shutting off the water.



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HYDRANTS

Made by R. D. Wood Company Public Ledger Building, Independence Square, Philadelphia 5, Pa. • Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Mathews Modernized Hydrants . . . Tops in Convenience and Dependability Compression-type valve prevents flooding • Head turns 360° • Replaceable head • Nozzle sections easily changed • Nozzle sections raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be lubricated • All working parts contained in barrel • A modern barrel makes an old Mathews good as new • Available with mechanical joint pipe connections

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND
Seals Bell and Spigot Water Mains
Economical—Effective
Over 35 Years Of Dependable Performance

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MAIN SALES OFFICE **50 CHURCH ST., N. Y. C.**
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YEAR after year, over 20,000 Sparling Meters measure main-line flows in water works, irrigation systems, sewage disposal plants, railroads, and a score of industries that require accurate liquid measurement over a wide range of flows. When you install a Sparling Meter you are in good company!

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KANSAS CITY 6 6 East 11th Street

ly from cutting lips to Parsons "Tap-In" teeth to meet any soil condition.

Verti-Flo Clarifier

923

Chain Belt Company, Milwaukee, Wis., has just printed a new **Rex Verti-Flo Bulletin.**

This 12-page bulletin illustrates and describes how Rex Verti-Flo, an improvement in settling tank design, can substantially reduce costs; assure clearer effluent; and increase overall plant efficiency. Line drawings graphically explain typical single and double tank arrangement. The new bulletin also stresses the advantages of Rex Floctrol in the pre-treatment of water.

ElectroniK Indicator and Console Operator's Desk

924

Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Philadelphia, Pa., has issued a specification sheet that describes and illustrates both the new console type operator's desk and the **Brown ElectroniK Precision Indicator.**

It describes the precision indicator for both single and multi-point indication of variables as well as the extended range indicator and shows how this indicator, when combined with the operator's desk and banks of switches, permits the operator to review and log many variable readings while sitting at the desk.

Filters

925

General American Transportation Corporation, Process Equipment Division, Chicago, Illinois, has available a 20-page, 2-color booklet on **Filters.**

The booklet discusses applications; operation; construction; auxiliary equipment; and standard sizes of the various filters manufactured by the company. Among the types discussed are: Conkey rotary drum vacuum filters; Conkey sludge filters; Conkey rotary disc vacuum filters; and Conkey rotary leaf pressure filters.

Photographs of each unit along with typical installations and dimensional drawings complete the booklet.

Proportioning Pump Catalog

926

Hills-McCanna Co., Chicago, Illinois, has just published an attractive 20-page, 2-color catalog giving full information on their line of mechan-

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ical drive **"U" Type Metering and Proportioning Pumps.**

Full specifications and prices are included plus a section on selection of "U" Type Pumps. The selection data makes it possible to specify the exact pump for any of over 300 listed substances that are successfully being handled with "U" Type pumps.

Controlled Volume Pumps and Automatic Chemical Feed Systems

927

Milton Roy Company, Philadelphia, Pa., has just published a new bulletin on **Controlled Volume Pumps and Automatic Chemical Feed Systems.**

The 24-page, 2-color bulletin gives complete details of construction, operation and application.

Cutaway views of the pumps and illustrated diagrams of controls and typical air-powered systems are used to clearly describe the method employed to harness air for controlled volume pumping. Air consumption and capacity-pressure tables are included for pumps handling from 0.4 to 405 gph against discharge pressures up to 21,000 psi.

Air Strainer for Use With Aeration Tanks

928

American Wheelabrator & Equipment Corp., Mishawaka, Ind., has available a booklet on **Dustube, for Efficient Dust and Fume Control.**

The booklet, on page 16, discusses how ultra-filtration of atmospheric air is obtained through a specially designed Wheelabrator Dustube system at the West-Southwest sewage treatment plant in Chicago.

As stated in the booklet dirt and other foreign materials are removed from the air prior to its being compressed and forced through the aeration tanks.

Weed Killer Service Bulletin

929

Agricultural Chemicals Dept. of the Pennsylvania Salt Manufacturing Company, Philadelphia, Pa., has prepared a new service bulletin on the **Uses and Application of Penite 6,** a non-selective weed killer.

Instructions are given in the bulletin for top growth and aquatic weed control and also explanations of the methods to be employed in soil treatment for the complete kill of weeds and grasses.

Penite 6 is also a control agent for termites, and formulations are furnished for preparing the proper solution for this use.

According to the bulletin, Penite 6 is a highly efficient method of debarking trees and is effective in the killing of trees and stumps.

Laboratory Supplies

930

Wilkens-Anderson Company, Chicago, Ill., has available copies of the **Waco Catalyst.**

This 20-page booklet gives complete information, and prices of the analytical laboratory instruments handled by the company. Autotrators, Buffer Tablets, pH Meters, Colorimeters, Nephelometers, and Spectrophotometers are among the many instruments covered in the booklet.

Pressure Type Filters

931

Graver Water Conditioning Co., New York, N.Y., has just published a 12-page, 2-color bulletin on **Pressure Type Water Filters.**

The bulletin describes the details of design and construction of these

SMITH BLAIR INC.

FLEXIBLE CAST-IRON COUPLINGS

- For cement-asbestos pipe
- For cast-iron pipe

Shown above: 6 in. Trans. (150 Barrel) x 4 in. Trans. (150 Barrel) x 4 in. Trans. (150 M.E.) x 6 in. C.I.

Featuring the "family characteristics" of all Smith-Blair products — durability, serviceability, and ease of installation — these flexible cast-iron couplings are designed to cut costs on many different installations:

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Expand... with EDDY MECHANICAL JOINT HYDRANTS

Mechanical Joint Connection Cuts Installation Time... Available With or Without the Auxiliary Valve...

Eddy Hydrants are ideally suited for emergency replacement or expansion of existing facilities, as well as for initial installation. They can be quickly installed in any kind of weather or in a flooded trench. A ratchet wrench is the only tool needed!

Large waterways insure a plentiful flow of water. Hydrant opens smoothly *with* the pressure and closes without water hammer. Stem held in place below main valve means no water loss due to a bent stem. When in closed position, the hydrant barrel is automatically drained by positive drip action to prevent freezing. Eddy Hydrants are bronze mounted throughout. One man can easily remove all operating mechanism for inspection or repair.

Send today for descriptive literature on Eddy Hydrants

EDDY VALVE COMPANY

A Subsidiary of James B. Clow & Sons

WATERFORD, NEW YORK

units, which are built in both vertical and horizontal types, together with all the accessory equipment which is furnished to help promote maximum efficiency.

The various available arrangements of valves and piping, and aids in their selection for individual requirements, are also fully discussed. Many illustrations of installations are included, together with complete tables of capacities, dimensions and weights for both horizontal and vertical filters.

Thermomenter Specifications Catalog

932

The Electric Auto-Lite Company, Instrument and Gauge Division, Toledo, Ohio, has just released a new 2-color **Thermometer Specifications Catalog.**

The 8-page catalog describes the complete line of auto-Lite recording thermometers and gauges as well as dial indicating thermometers. Applications, chart ranges, dial ranges and accessories are listed in the booklet, with blue-print illustrations to show the varied types of installations of Auto-Lite instruments.

Instructions for ordering also are included in the catalog.

ROTO-TROL 940

Installations of *Roto-Trol 940* are in constant operation in all parts of the country. In each plant, they are controlling pumps, valves, and/or alarm circuits, etc., from one float. Many installations have several starting and stopping positions, both rising and falling. Each circuit is independent. Mercury switches with snap action are used. *940* can be set on the job.

Write for Bulletin

Water Level Controls Division

HEALY-RUFF COMPANY

783 Hampden Ave. St. Paul 4, Minn.

CUT COSTS ON UNDERGROUND PIPING JOBS

...with a GREENLEE PIPE PUSHER

Installing pipe underground is quick and simple this way. With a GREENLEE Hydraulic Pipe Pusher *one man* pushes pipe through the ground—under streets, railways, walks, lawns, floors. Saves time, cuts costs through elimination of extensive ditching as just a short trench accommodates the Pusher. No tearing up of pavement, lawns, floors... eliminates tunneling, back-filling, tamping, repaving. Cuts job time to a fraction. Pusher often pays for itself through timesavings on first job or two.

No. 790 GREENLEE PUSHER For 3-4 to 4-inch pipe. Six speeds—5,600 to 40,000 lbs. pushing pressure.

No. 795 GREENLEE PUSHER For pipe larger than 4-inch, concrete sewer pipe, large drainage ducts. Six speeds—25,000 to 150,000 lbs. pushing pressure.

POWER PUMP For both sizes of GREENLEE Pushers. Pushes pipe at rate of two feet per minute.

GREENLEE

Get facts on timesaving Greenlee tools now. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 2249 Columbia Avenue, Rockford, Illinois, U. S. A.

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

Pipe Tool Catalog

933

Beaver Pipe Tools, Inc., Warren, Ohio announces the completion of a new 1952 **Catalog and Data Book.**

The new catalog gives pertinent information on three pipe and bolt machines: Models A, B, and E; Power Units C-1 and C-2; Ratchet Threaders; Reamers, Cutters and other pipe tools in the hand and power classification.

Four pages in the back of the catalog are devoted to the popular and instructive "Operating Guide." Fully illustrated with easy-to-grasp pen and ink drawings and technical copy that quickly tells how to locate and correct pipe tool troubles, the "Operating Guide" clarifies 31 different operations.

Air Compressor Bulletin

934

Davey Compressor Co., Kent, Ohio, has just released a new 4-page bulletin descriptive of all types of **105 c.f.m. Davey Compressors.**

Davey gasoline, diesel and electric-powered trailers; "Auto-Air" truck-mounted units and industrial stationary machines are listed and illustrated in detail. Complete mechanical specifications are included in a handy reference table.

Water Repellent for Masonry Surfaces

935

Surface Protection Co., Cleveland, Ohio, has released a 4-page **Product Manual on "Silaseal,"** a silicone type transparent water repellent.

This instructive booklet describes the uses and application of this silicone development; how porous exterior masonry surfaces can be successfully treated so that they are completely water repellent.

Highlighted in the literature is a section devoted to the control and elimination of efflorescence.

Stationary Diesel Bulletins

936

National Supply Company, Springfield, Ohio has just released 3 8-page bulletins on the **Models 45, 40, 60 & 80 Stationary Diesel Engines.**

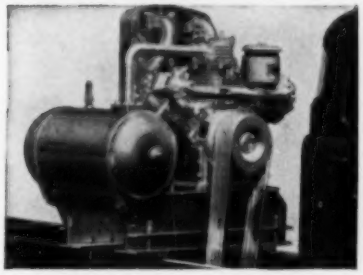
The Model 45 is described as a 6 or 8 cylinder engine and is available in capacities from 240 to 600 h.p. Model 40 is available in 6 and 8 cylinder sizes and capacities from 215 to 650 h.p. Models 60 and 80 are supplied in 6 and 8 cylinder sizes and in capacities from 410 to 1440 h.p.

JAEGER TRAVEL-AIR COMPRESSOR
with power take-off plus . . .

more air-125 cfm

no vibration

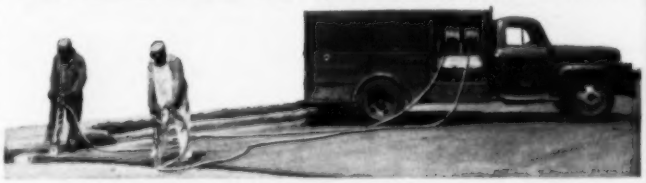
simple automatic engine speed control



Perfectly balanced "W" compressor, operated thru Cemco power take-off (no gears, only 4 moving parts) keeps 2 heavy breakers working at full efficiency with your truck engine running at easy 1750 rpm (24 mph speedometer). Engine speed automatically regulated to air demands by simple, positive control—no complicated linkage. Send for Catalog TC-1.

Saves $950 to $1000 first cost and 50% of maintenance compared with trailer types. Mounts on long wheelbase 1½ and 2 ton Chevrolet, Dodge, Ford, GMC, International.

THE JAEGER MACHINE CO., 680 Dublin Ave., Columbus 16, Ohio
PUMPS • MIXERS • PAVING MACHINERY



"GUNITE" Lining Restores Reservoir

When the old, open Ballou Park Reservoir at Danville, Va., was improved and covered in 1948, excessive leakage of the old brick lining was stopped with reinforced "GUNITE". The photo shows details of the process. After concrete columns to support the roof were placed, wire mesh reinforcing was laid and the entire reservoir was "GUNITED". Note that the reinforcing and "GUNITE" were carried over the column footings and up the columns approximately three feet to prevent leaking at those points.

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin C2400. We will gladly send a copy at your request. On your letterhead, please.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN

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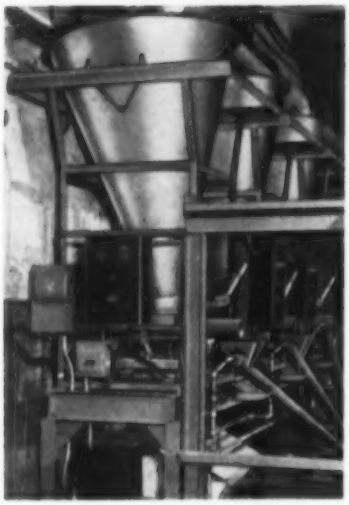
For Feeding Dry Chemical Reagents—



3 Open Model FM-1-80 Feeder Machines feeding in a water treatment system. (Also available in Cabinet style Models for different sized treatment systems.)

SYNTRON

"Vibra-Flow"

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Index of Instrumentation Literature

937

Minneapolis-Honeywell Regulator Company, Brown Instruments Division, Philadelphia, Pa., has just released an **Index of Literature** covering instrumentation.

The index consists of both a numerical listing and alphabetical cross index for specification sheets, instrumentation data sheets, catalogs and other literature. Included in the alphabetical index are articles from "Instrumentation", a quarterly publication of the company.

Diesel Engines and Standby Power Units

938

International Harvester Company, Chicago, Ill., has available a 24-page, 2-color booklet on **International Diesel Engines and Power Units.**

The booklet describes in great detail the operating features of the units and cutaway drawings show

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operating procedures. Specifications of all models, performance charts, and photographs of each unit are also included.

Roller Chain Engineering Data Book

939

Link-Belt Company, Chicago, Ill., has just published a new 148-page **Roller Chain Engineering Data Book.**

It is one of the most comprehensive books on roller chain and its application. Detailed engineering information covers the selection, installation, lubrication, and maintenance of roller chain for drives and conveyors, and sprocket wheels.

For reference and easy identification, the book contains a large number of photographs and line drawings of the many types and sizes of chain and sprocket wheels available from Link-Belt. In addition, over 50 typical conveyor chain attachments are shown.

Valuable Water & Sewage Works Catalog

940

Chicago Pump Company, Chicago, Ill., has made available a large 288 page catalog on **Chicago Pumps.**

The catalog, profusely illustrated, is composed of technical and information bulletins on each of the company's products. It is broken down into 7 basic categories: Useful information; Horizontal Pumps;

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This catalog should prove a valuable asset to any water and sewage library.

Water Storage in Elevated Steel Tanks

941

Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., has just published a new 20-page, 2-color brochure on **Modern Water Storage in Elevated Steel Tanks.**

With some 50 installation photographs, the bulletin presents data on

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A section of the brochure is devoted to accessory equipment. New tanks for old towers and foundations also are discussed briefly.

Liquid Strainer for Removal Of Grit, Sand, Etc.

942

Golden-Anderson Valve Specialty Company, Pittsburgh, Pa., has just published a new 2-page bulletin illustrating the **Ideal Liquid Strainer.** The strainer is used for the removal of sand, grit, etc., from lines of from 3 to 24 inch diameter.

The application, parts lists, working pressures and dimensions are fully described along with a diagram showing installation arrangements.

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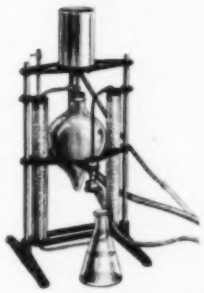

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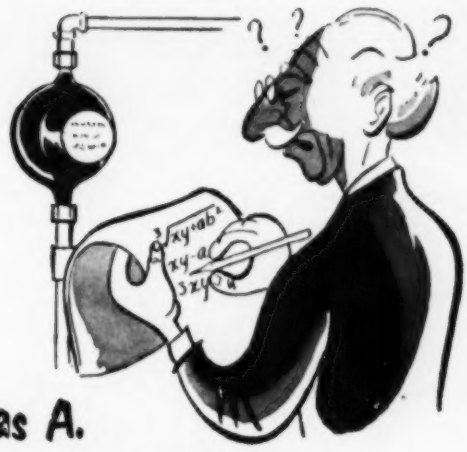

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Years of Operation	13
Total Repair Cost	$848.83
Repair Cost *per unit*	$ 53.05
Repair Cost, per unit, *per year*	$ 4.08
% of Original Cost spent for all repairs in 13 years	0.6%

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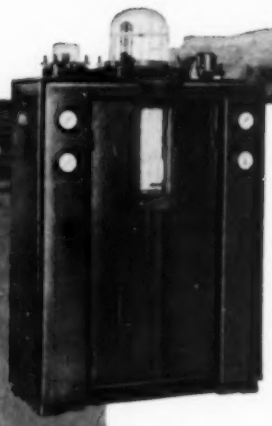

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